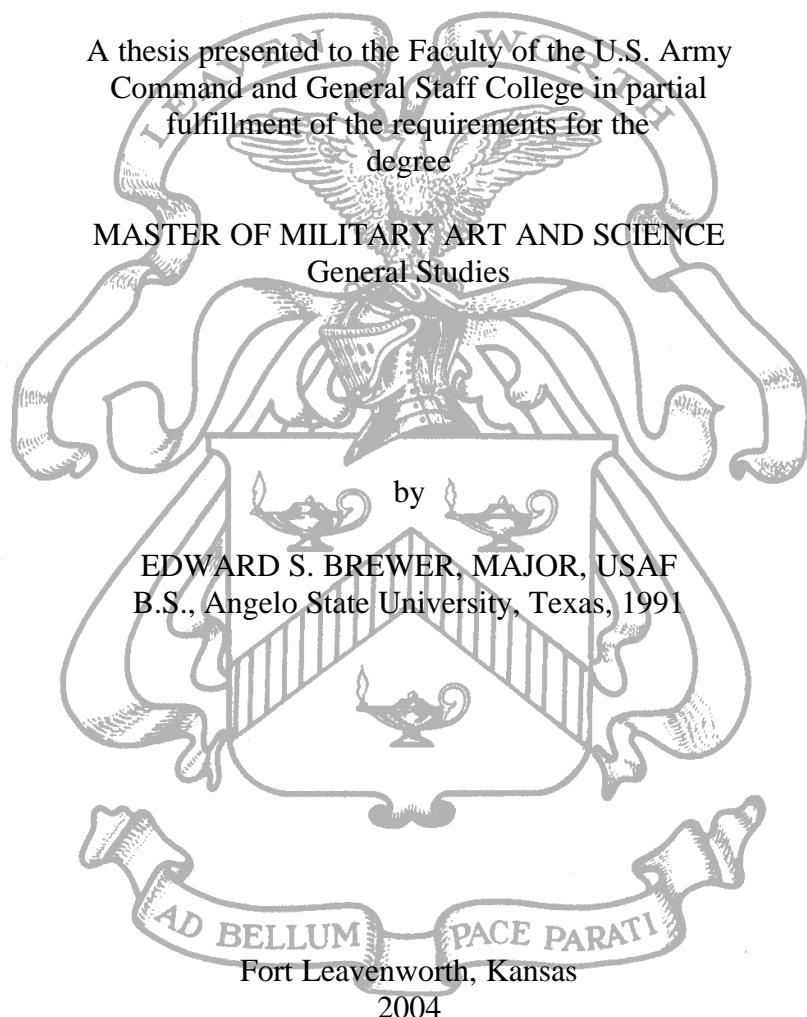


A COMMERCIAL SOLUTION
TO THE INTERTHEATER AIRLIFT SHORTFALL



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MASTER OF MILITARY ART AND SCIENCE

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ABSTRACT

A COMMERCIAL SOLUTION TO THE INTERTHEATER AIRLIFT SHORTFALL,
by Maj Edward S. Brewer, USAF, 87 pages.

With the United States' reliance on rapid power projection, there is little prospect demands on airlift will decrease. On the contrary, today's significant gap between requirements and capabilities will likely increase as the nation faces new challenges prosecuting the war on terrorism. One of which is the increased likelihood of airlift forces operating in hostile environments due to the proliferation of weapons of mass destruction and man-portable surface-to-air missiles.

There are several possible mainstream solutions to meet growing airlift demands including purchasing additional military-style aircraft, refurbishing aging aircraft, increasing Civil Reserve Air Fleet involvement, stockpiling more pre-positioned equipment, or increasing burden sharing with allies. This thesis asks whether complementing Air Mobility Command's current military-style aircraft fleet with commercially available aircraft is the most fiscally responsible option for solving Department of Defense's intertheater airlift shortfall?

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ACRONYMS

AFRC	Air Force Reserve Command
AMC	Air Mobility Command
AMOCC	Air Mobility Operations Control Center
AMOG	Air Mobility Operations Group
ANG	Air National Guard
APOD	Aerial Port of Debarkation
APOE	Aerial Port of Embarkation
CONUS	Continental United States
CRAF	Civil Reserve Air Fleet
DoD	Department of Defense
EMTF	Expeditionary Mobility Task Forces
FAA	Federal Aviation Administration
FY	Fiscal Year
MAC	Military Airlift Command (inactivated; now AMC)
MOOTW	Military Operations Other Than War
MTM/D	Million Ton Miles per Day
NDAA	Non-Developmental Airlift Aircraft
TACC	Tanker Airlift Control Center
TPFDD	Time-Phased Force and Deployment Data
USAF	United States Air Force
USTRANSCOM	United States Transportation Command

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CHAPTER 1

INTRODUCTION

Air power is the total aviation industry--civilian and military, commercial and private, potential as well as existing.

General Henry H. "Hap" Arnold

Overview

Intertheater airlift is a key instrument of national power during peace and war. The ability of the United States to deter aggression, provide humanitarian assistance, limit conflict, or to wage war demands the capability to rapidly mobilize, deploy, and sustain military forces from multiple, dispersed locations. Inherent in that capability is the requirement for a strong intertheater airlift force capable of immense global reach. By complementing sealift and pre-positioned assets, intertheater airlift power projection provides national policymakers with credible military options to mitigate potential crises and enables them to play upon the world stage at whatever level they choose.

The United States' national military strategy has changed its centerpiece drastically since the fall of the Berlin Wall. Replacing the strategy of forward presence with global power projection in 1991 was due to a new set of less distinct, yet more complex, challenges presented to combatant commanders. These changes reflect an increasingly complicated world order with the United States as the sole superpower. In such an uncertain environment, the United States faces the difficult challenges of prosecuting a war to defeat terrorist organizations that do not have clearly defined borders, preventing proliferation of weapons of mass destruction, the increased likelihood of being drawn into sudden regional conflicts, and reacting to humanitarian crises in

underdeveloped regions. During the Cold War, the United States' national military strategy relied on a robust infrastructure and well-equipped, sophisticated allied armed forces focused almost exclusively on defeating the Soviet Union and the Warsaw Pact. Today, the majority of the United States' military is located in the Continental United States (CONUS). With fewer and fewer forces permanently stationed overseas, the United States relies on its capability to project military power abroad to respond quickly to threats against its national security. Due to the United States limited overseas military presence, credible power projection capabilities serve as a deterrent to potential adversaries and provides national leaders increased flexibility to respond to crises worldwide.

The Chairman of the Joint Chiefs of Staff vision calls for the capability to dominate an opponent across the full spectrum of military operations. Air Mobility Command (AMC) fulfills this challenge by rapidly projecting military power with its organic intertheater airlift assets consisting of C-5, C-17, C-141, KC-10, and KC-135 aircraft. The KC-10 and KC-135 are primarily tankers, but can transport a limited amount of cargo at the expense of reducing their fuel load. By trading fuel for cargo, tankers limit their refueling effectiveness to project fighter, bomber, special operations, and other intertheater airlift assets quickly to a crisis. The C-5, C-17, and C-141, on the other hand, were specifically designed to accomplish intertheater airlift of military forces. These aircraft are capable of performing specialized airlift tasks including direct delivery to forward operating locations with short and semi-improved runways, transporting oversize or outsize cargo, using night vision devices and operating tactically at low altitude to evade threats, airdropping paratroopers and equipment, and refueling inflight. To meet

these demanding military-specific requirements, these three aircraft are designed with additional features that increase weight, fuel consumption, and maintenance requirements, as well as reduce aircraft speed. This translates into increased flight time to a crisis area (if aerial refueling is not used), extended ground stops, and increased operating costs. Thus, there are tradeoffs for military intertheater airlift aircraft's added flexibility, and they are reduced efficiency and reduced reliability.

Completing the United States' national airlift capability is the Civil Reserve Air Fleet (CRAF). This unique capability is comprised of domestic civil air carriers that contractually pledge themselves to support Department of Defense (DoD) when airlift requirements exceed the military's capability, from minor contingencies to full national defense emergencies. The CRAF was created in 1952 due to a shortfall in military airlift and delays in establishing contracts with commercial airlines at the start of the Korean conflict (Brown 1987, 12).

Today, the CRAF makes up a significant portion of the nation's mobility resources. In return for their involvement, CRAF participants are awarded DoD's peacetime passenger and cargo contract business. This not only provides a source of revenue for domestic air carriers, but also provides DoD with a very cost-effective source of augmentation and relieves the United States Air Force (USAF) from having to own, maintain, and operate a larger intertheater airlift fleet. International Airlift Services is the largest contract DoD offers to CRAF participants. For fiscal year (FY) 2003, the guaranteed portion of this contract was \$394 million. AMC estimated that throughout FY2003, it will also award more than \$224 million in additional business that is not

guaranteed (USAF 2003a). Table 1 highlights the significant contributions of the CRAF to several major DoD operations during the 1990s.

Table 1. Participation of Commercial Air Carriers in Peacetime Contingencies

Location	Operation	Year Operation Began	Cargo Delivered (tons)	Passengers Delivered
Philippines	Fiery Vigil	1991	2,412	16,882
Northern Iraq	Provide Comfort ^a	1991	2,898	18,294
Former Soviet Union	Provide Hope	1992	4,895	100
Bosnia	Provide Promise	1992	145	2,345
Somalia	Restore Hope	1992	463	52,136
Rwanda	Support Hope	1994	2,138	548
Cuba	Sea Signal V	1994	848	29,524
Panama	Panama Haven/Safe Haven	1994	NA	4,647
Haiti	Phoenix Shark	1994	1,823	33,546
Cuba	Safe Haven/Safe Passage	1994	0	4,050
Persian Gulf	Vigilant Warrior	1994	1,389	12,010
Bosnia	Joint Endeavor ^b	1995	7,300	41,000

a. As of August 1995.

b. As of January 1997.

Source: United States Congressional Budget Office, *Moving United States Forces: Options for Strategic Mobility*, 1997, 85; [database on-line]; available from <http://www.cbo.gov/showdoc.cfm?index=11&sequence=0>, internet, accessed 20 September 2003.

To join the CRAF, air carriers must maintain minimum long-range international fleet commitment levels. All aircraft must be United States registered, be capable of over water flight, have at least a 3,500-nautical-mile range, and have utilization rate of at least ten hours per day. Carriers must also commit and maintain at least four complete aircrews for each aircraft. As of January 2003, 33 carriers and 927 aircraft were enrolled in the CRAF. This includes 685 aircraft in the international intertheater segment and the

remainder of the CRAF in the national and aeromedical evacuation segments. Within the international segment, 593 aircraft are in the long-range section and 92 are in the short-range section (USAF 2003a).

The CRAF is comprised of commercial aircraft designed to carry large payloads over long distances. These aircraft accomplish this task cheaper than their military counterparts do because they are specifically designed for efficiency and reliability. Nothing that does not benefit the corporate bottom line is included because the airline industry is unwilling to pay for excess utility that is rarely used. Instead, commercial aircraft concentrate on aerodynamics, avionics, and bulk cargo carrying capacity. Aerodynamically efficient, commercial aircraft normally require longer runways to take off and land, but are faster and more fuel efficient. Since International Civil Aviation Organization (ICAO) standards drive civil aviation industry requirements, commercial aircraft are typically better equipped to use the world's air route system. Finally, since commercial cargo aircraft's main purpose is to make profits, they typically carry more cargo, over longer distances, than their military counterparts do. To reduce aircraft complexity and operating costs, commercial aircraft use side-mounted cargo doors. This requires special high-reach-capable material handling equipment to elevate cargo for loading and unloading operations. Thus, commercial aircraft are limited to airfields where this support equipment is available.

When combined, this team of organic military and outsourced commercial aircraft has provided the United States its global reach. This civil and military airlift team has served the nation well, providing tremendous capability at a relatively low cost. For DoD to replace the CRAF's Stage II capability with organic military aircraft would cost \$2

billion annually and replacing Stage III would cost an additional \$3 billion (Gebman et al. 1994a, 21).

However, since 11 September 2001, the security environment throughout the world has changed dramatically. The United States now finds itself fighting a long-term war against terror on an unstable and unpredictable battlefield that spans the globe. Where the CRAF once enjoyed protection from conventional enemy attack, today, there are no sanctuaries. Terrorist organizations have demonstrated civil carriers are prime targets to influence and shape the battlefield. Thus, defenseless civil carriers may not desire, nor may military commanders allow them, to operate in high threat areas. This will certainly increase the demands for organic DoD intertheater airlift assets.

Unfortunately, years of budget constraints, force downsizing, and the steady withdrawal of United States' armed forces from permanent overseas bases have limited AMC's organic intertheater airlift options available to the President, Secretary of Defense, and combatant commanders. The *Mobility Requirements Study FY2005* established AMC's minimum level of capacity to support the *National Military Strategy* at 54.5 million ton miles per day (MTM/D). This figure assured moderate risk for two nearly simultaneous Major Theaters of War but assumed perfect command and control, perfect scheduling, no broken aircraft congesting the system, and no delays for weather, political clearances, air traffic restrictions, or airfield operating hours. When these constraints and others regarding warning time, national level decision making, CRAF activation, levels of allied support, and warfighting timelines are relaxed from their very optimistic levels, risk drives the intertheater airlift requirements up to 67.0 MTM/D (DoD 2001b, 4). The 54.5 MTM/D figure represented a good planning base line but the

increasingly expeditionary nature of DoD force employment combined with escalating Homeland Security responsibilities and the global war on terrorism has likely increased the nation's airlift requirements. The *Air Mobility Strategic Plan 2002 Update* highlighted DoD's shortfall when it assessed AMC's combined organic military and contracted CRAF intertheater airlift capacity at 46.07 MTM/D (AMC 2002, 64). A figure that falls significantly short of meeting stated goals and objectives of the current *National Military Strategy* of engagement.

Arguably, DoD has become a one war force. Intertheater airlift might be indispensable to the American way of war, but AMC's airlift fleet can handle no more than one major regional conflict at a time. This is hardly a military secret; it has been an acknowledged shortfall for years. Operation Iraqi Freedom highlighted this fact by underscoring today's delicate balance of needs versus capabilities. DoD's intertheater airlift fleet not only faced the demands of a full-scale major theater war, but also had to meet ongoing airlift requirements of other engaged combatant commanders. These included supporting peacekeeping operations in Bosnia and Kosovo, Operation Noble Eagle homeland defense missions, continuing operations in Afghanistan, and helping reinforce South Korea--all during the ongoing Iraqi operation. Supporting all of these requirements pressed intertheater airlift forces to their limits. General Tommy R. Franks, commander of United States Central Command, was forced to modify his original war plan to live within DoD's limited airlift capacity. This shortfall forced commanders to make choices between competing high priority missions. The eruption of a second major regional crisis--say, on the tense Korean peninsula--would have brought the United States face to face with painful choices of how to meet the combat needs of two theater

commanders, and in what order. Combined with increasing demands to support Military Operations Other Than War (MOOTW), there is a need to rewrite outdated airlift requirements.

The United States is a nation with global interests. As such, it must remain engaged in order to influence world events. The United States' ability to project and sustain military forces rapidly to counter crises anywhere in the world will remain the cornerstone of its national military strategy and continue to be one of its most evident signs of national power.

There are several possible mainstream solutions to AMC's intertheater airlift shortfall including purchasing additional purely military aircraft, like the C-17; refurbishing aging aircraft, like the C-5; increasing pre-positioned equipment and supplies; increasing CRAF involvement; or burden sharing with allies. Are there others? Can DoD increase its global reach by fielding a mixed fleet that maximizes the benefits of both military-style and commercial-style aircraft used in the CRAF? This study explores whether purchasing commercially available aircraft, built for their efficiency and reliability, represent the best fiscally responsible option to complement DoD's current flexible intertheater airlift fleet and meet the nation's growing demands.

Primary Question

This thesis asks whether complementing AMC's current military-style aircraft fleet with commercially available aircraft is the most fiscally responsible option for solving DoD's intertheater airlift shortfall?

Secondary Questions

To answer the primary question, a number of secondary questions will also be addressed. What are DoD's intertheater airlift requirements? Is there an intertheater airlift shortfall? What are the benefits of commercial aircraft compared to traditional military aircraft? Are there restrictions or limitations preventing the CRAF from successfully meeting military intertheater airlift requirements? Can a DoD operated mixed fleet of military and commercial aircraft meet combatant commander's requirements for bulk and outsize cargo along with specialized tasks like airdrop operations, oversize cargo, and operating in austere locations?

Assumptions

This thesis uses six key assumptions. First, the United States will remain the sole military superpower and maintain its policy of engagement. Second, the USAF will continue to procure new intertheater airlift aircraft from within a limited budget. Third, the current relationship in purchase, operating costs, and reliability rates of military aircraft versus commercial aircraft will remain comparable in the future. Fourth, AMC will continue to replace or modernize older 25K, 40K, and wide-body loaders with 318 60K Turner Loaders and 264 Next Generation Small Loaders (Air Force News Release 1998; AMC 2002, 325). More important than the increased weight capacity is the newer high-reach-capable loaders can load and unload cargo from all military and commercial aircraft and thus, will increase the feasibility of accepting commercial cargo aircraft at more USAF installations. Fifth, the United States' national security strategy will continue to place high demands on its intertheater airlift force. Sixth, intertheater airlift will

maintain its position as the preferred method to rapidly deploy forces around the world, especially as the United States Army continues its transformation.

Limitations

This thesis will be constrained by a six-month period of research and the documents developed to that point. It will not address the personnel and infrastructure effects of increasing capacity, even though a possibility exists of saturating the existing global airlift mobility system. In addition, the figures used for the purchase and operating costs of a generically configured commercial aircraft are based on single unit purchases listed on the aircraft manufacturer's website and an estimation of costs for modification. These costs do not reflect a final negotiated price of procuring and operating a fleet of intertheater transports, or possible additional refueling and special mission airlift aircraft.

Delimitations

The scope of this project is delimited to the broad topic of comparing a generic commercial cargo configured aircraft to DoD's C-17 Globemaster III. The author chose the C-17 for comparison because it is the only USAF intertheater airlift aircraft currently in production. The C-5 and C-141 could also be explored as options, but both of these aircraft have been out of production for a number of years and significant costs would be incurred to redesign and retool manufacturing facilities. A specific commercial aircraft procurement recommendation will not be made, nor the exact number required satisfying the USAF's current intertheater airlift shortfall. Although these two questions are answerable, to do so would require extensive research into the capabilities of every commercial aircraft and the numerous airlift requirements of DoD. This level of research will be beyond the limited scope of this project.

A Boeing 767-300F aircraft, modified for cargo operations, will be used as the baseline commercial aircraft due to its wide acceptance and proven record. There are, of course, numerous other reasonable commercial aircraft solutions built by Boeing, as well as other domestic and foreign manufacturers. Although the smaller cabin of the 767-300F cannot accommodate as great a range of oversize cargo as larger commercial cargo aircraft, like the Boeing 747-400F, more 767-300Fs could be procured for the same investment. This increases operational flexibility since more locations could potentially be serviced simultaneously. Furthermore, by augmenting the USAF's current intertheater airlift fleet with a capable intermediate-size, wide-body transport, like the 767-300F, the Tanker Airlift Control Center (TACC) could focus its limited C-5 and C-17 assets on missions requiring these aircraft's special capabilities, including direct delivery missions, transporting outsize cargo, and airdrop operations.

Key Terms

Aerial Refueling. Aerial refueling is the practice of transferring fuel from one aircraft to another during flight. This allows the receiving aircraft to remain airborne longer, and to take off with a greater payload. Also called inflight refueling (IFR) or air-to-air refueling.

Air Mobility Command (AMC). AMC is the USAF component of the United States Transportation Command (USTRANSCOM). AMC's primary mission is rapid, global air mobility and sustainment of United States' armed forces. AMC is the single manager for air mobility, air refueling, special air missions, and aeromedical evacuation. Note: On 1 June 1992, Military Airlift Command (MAC) and Strategic Air Command were

inactivated and AMC formed from airlift and aerial refueling forces formally assigned to these two organizations.

Air Mobility Master Plan. This document, published by AMC, assesses the capability of people, infrastructure, and equipment and provides broad air mobility planning factors for peacetime and wartime operations. Designed to help service, joint, and combined planners make gross estimates about mobility requirements in the early stages of the planning process, it covers airlift, air refueling, and aeromedical evacuation.

Avionics. The onboard electronics used for piloting an aircraft are called avionics. Avionics include communications and navigation systems, autopilots, and electronic flight management systems. Onboard electronics that are unrelated to piloting tasks, such as video systems for passengers, are not considered avionics.

Boeing 767-300 Freighter. The Boeing 767-300 Freighter is a derivative of the 767-300ER (extended range) passenger twinjet. This aircraft has advanced avionics, aerodynamics, propulsion systems, and a cargo-handling system that provides complete automation of the cargo loading process. Its design provides excellent fuel efficiency, operational flexibility, and a schedule reliability rate (an airline industry measure of departure from the gate within 15 minutes of scheduled time) of nearly 99 percent (Boeing Company 2003a). The Boeing 767-300F can transport approximately 131,800 pounds (59,783 kilograms) of payload more than 3,500 nautical miles (6,482 kilometers) (AMC 2001, 31). Boeing's official website estimates purchase costs of a single Boeing 767-300F from \$122.5 to \$134.0 million, depending on overall configuration requirements (Boeing Company 2003a).

C-5 Galaxy. The C-5 is the largest airlift aircraft in AMC's airlift force. The first operational C-5A was delivered in 1969 and the first operational C-5B was delivered in 1986. Specifically designed to carry the largest military equipment, this aircraft's nose and aft doors open to the full dimensions of the cargo compartment. The C-5 features the ability to lower its fuselage by "kneeling," thereby reducing the height of the aircraft for loading and unloading. The C-5 can transport a maximum payload of 291,000 pounds (131,995 kilograms) 1,530 nautical miles (2,834 kilometers) or 180,000 pounds (816,47 kilograms) 3,200 nautical miles (5,926 kilometers). With air refueling, the C-5's range is limited only by crew endurance. The C-5 also has the ability to airdrop personnel and equipment. The United States' fleet consists of 76 C-5A model and 50 C-5B model aircraft (USAF 2003a and AMC 2002, 103).

C-17 Globemaster III. The C-17 is the newest, most flexible airlift aircraft to enter AMC's airlift force. The first operational C-17 was delivered in 1993 and since then, has replaced the C-141 as AMC's core airlifter. This aircraft was designed to meet military-specific requirements and provides flexibility to support both intratheater and intertheater missions. Some of these missions include direct delivery, transporting outsize cargo to austere runways as short as 3,000 feet (914 meters), aeromedical evacuation, and airdrop insertion of up to 102 paratroopers and equipment. Four, fully reversible, engines power the aircraft. A unique feature of these engines are the thrust reversers which direct the flow of air upward and forward to limit ingestion of dust and debris. This system also permits the aircraft to back up. The C-17 is one of the most reliable transport aircraft in the USAF, with an aircraft mission completion success rate of 92 percent, 20 aircraft maintenance man-hours per flying hour, and full mission availability rate of 74.7 percent

and partial mission availability rate 82.5 percent. Cargo is loaded through a large aft door that can accommodate palletized cargo, military vehicles, and virtually all of the Army's air-transportable equipment. Maximum payload capacity of the C-17 is 170,900 pounds (77,519 kilograms). With a payload of 160,000 pounds (72,575 kilograms), the C-17 has an unrefueled range of approximately 2,400 nautical miles (4,445 kilometers) or 110,000 pounds (49,895 kilograms) 3,200 nautical miles (5,926 kilometers). With air refueling, the C-17's range is limited only by crew endurance. The C-17 costs \$236.7 million each to procure in FY98 constant dollars (USAF 2003a and AMC 2002, 121). In 2002, Boeing was awarded a second multiyear production contract worth \$9.7 billion for the C-17, which is expected to raise the overall total number of C-17s to 180. USTRANSCOM desires, at the minimum, 222 C-17s, and in the past has cited 2006 as the year to insert money for another C-17 buy for long-lead components (Cortes 2003, 6).

C-141 Starlifter. The C-141 was AMC's core airlift aircraft until the C-17 assumed this role. Built between 1963 and 1967, this was the first jet aircraft specifically designed for military missions. The C-141 can transport bulk and oversize cargo, but not outsize. The C-141 can transport a maximum payload of 68,000 pounds (30,844 kilograms) 2,2270 nautical miles (4,204 kilometers) or 32,000 pounds (14,515 kilograms) 3,200 nautical miles (5,926 kilometers). With air refueling, the C-141's range is limited only by crew endurance. The C-141 also has the ability to airdrop personnel and equipment. The C-141 has been retired from the active force and is due for complete retirement from the Air National Guard (ANG) and Air Force Reserve Command (AFRC) in FY2006 (USAF 2003a and AMC 2002, 169).

Cargo. There are five different classifications of military cargo including bulk cargo, oversize cargo, outsize cargo, rolling stock, and special items. Bulk cargo includes cargo within the usable dimensions of a standard 463L pallet (104 inches by 84 inches by 96 inches). Oversize cargo exceeds the usable dimensions of a 463L pallet loaded to the design height of 96 inches, but is equal to or less than 1,090 inches in length, 117 inches in width, and 105 inches in height. Outsize cargo exceeds the dimension of oversize and requires the use of either a C-5 or C-17 aircraft. Examples of outsize cargo include M1 tanks, Patriot battery radars, and Apache helicopters. Rolling stock equipment can be driven or rolled directly into the cargo compartment. Special items require specialized preparation and handling procedures, such as space satellites or nuclear weapons.

Civil Reserve Air Fleet (CRAF). The CRAF is a voluntary program between DoD and domestic passenger and cargo civil air carriers (aircraft owned by a United States entity or citizen). In exchange for incentives, civil air carriers agree to provide aircraft and crews to supplement the nation's airlift capability during national emergencies. The CRAF has three main segments that include international, national, and aeromedical evacuation. The role of the international segment is to augment AMC's long-range intertheater C-5s, C-17s, and C-141s during periods of increased airlift needs. This is accomplished in stages, allowing DoD to tailor the CRAF force mobilized to its requirements. Each succeeding stage activated provides increased airlift augmentation. Stage I is for minor regional crises; Stage II is used for major regional contingencies; and Stage III is used for periods of national mobilization (USAF 2003a).

Direct Delivery. The air movement of personnel and cargo from the aerial port of embarkation (APOE) to a location as close as practical to the desired final destination.

Fiscal Year (FY). For DoD activities, the fiscal year begins on 1 October of the year prior to the calendar year and ends on 30 September of the calendar year.

Intertheater Airlift. Airlift linking theaters to the CONUS and to other theaters as well as the airlift within the CONUS. The majority of intertheater airlift assets are assigned to the Commander, USTRANSCOM. Due to the distance typically involved, intertheater airlift is normally conducted by heavy, longer range intercontinental airlift aircraft, but may also be conducted with shorter range aircraft when required. Formerly referred to as strategic airlift (DoD 2001a, 278).

Intratheater Airlift. Airlift conducted within a theater. Assets assigned to a geographic combatant commander or attached to a subordinate joint force commander normally conduct intratheater airlift operations. Intratheater airlift provides movement and delivery of personnel and equipment directly into objective areas by either landing or airdrop insertion. During large-scale operations, intertheater airlift assets may be tasked to augment intratheater airlift operations. Formerly referred to as theater airlift (DoD 2001a, 279).

Million Ton Miles per Day (MTM/D). An aggregate, unconstrained measure of airlift capacity or requirements. Simply, MTM/D is the number of millions of tons that could be moved one mile per day. MTM/D is a formula that accounts for aircraft factors such as speed, payload capacity, and maintenance reliability (AMC 1997, 2-28). Quantifying airlift requirements by MTM/D provides planners with a quick comparison tool, but does have limitations. MTM/D ignores airfield infrastructure constraints, differences in types of cargo, and the wide range of mission scenarios (AMC 1997, 2-26). MTM/D is a simple measure of airlift effectiveness and is the mainstay of requirements

planning since it provides leaders with a quick and quantifiable comparison for mobility capability.

National Airlift Policy. *National Security Decision Directive Number 280*, signed by President Reagan on 24 June 1987, set the current national airlift policy objective to ensure military and civil airlift resources will be able to meet defense mobilization and deployment requirements in support of United States' defense and foreign policies. The broad purpose of this directive was to provide a framework for implementing actions in both the private and public sectors that would enable the United States efficiently and effectively to meet established requirements for airlift in both peacetime and in the event of crisis or war.

Payload. The load an aircraft transports, usually expressed in short tons of cargo or number of passengers.

Planning Payload. The payload expected on a fleet-wide basis used to make initial gross planning estimates. Due to size, shapes, and density of most payloads, rarely are aircraft loaded to 100 percent capacity. Therefore, planning payload data, not maximum payload data, should be used for planning purposes.

United States Transportation Command (USTRANSCOM). The unified command responsible for providing strategic air, land, and sea transportation and common-user port management across the full range of military operations for DoD.

Summary

This chapter introduced the primary question and asks whether complementing AMC's current military-style aircraft fleet with commercially available aircraft is the most fiscally responsible option for solving DoD's intertheater airlift shortfall?

Secondary questions, assumptions, limitations, and delimitations affecting the study were also detailed. In addition, key terms used were defined.

Chapter 2 examines significant works concerning the United States' national airlift requirements. This chapter provides an overview of the national airlift system, highlights the challenges both DoD and the CRAF airlift forces face in today's operating environment, documents the shortfall in the current intertheater airlift capacity, and presents other authors' proposed solutions to solving this intertheater airlift shortfall.

Chapter 3 describes the conduct of the research methodology used to determine the feasibility of commercial-style aircraft solving DoD's intertheater airlift shortfall.

Using the research methodology introduced in chapter 3, chapter 4 analyzes the feasibility of commercial-style aircraft solving DoD's intertheater airlift shortfall. The author will outline the strategic mobility structure and explain the partnership between military and civil air carriers, as defined by the United States's national airlift policy. Past DoD mobility studies will be reviewed to determine the United States' intertheater airlift requirements and highlight how these studies have continually undercut the nation's airlift needs. The author will illustrate the differences between military requirements for flexible aircraft and commercial requirements for reliability and efficient aircraft. Within the context of the current operating environment, the benefits and liabilities of both styles of aircraft will be explained. Lastly, a cost comparison of procuring and operating a C-17 versus a Boeing 767-300F will be made.

Chapter 5 presents the conclusions reached from analysis of the data and presents recommendations for action. This chapter also suggests continued or related studies and

summarizes additional benefits realized by using commercial-style intertheater airlift aircraft.

CHAPTER 2

LITERATURE REVIEW

Not to have an adequate air force in the present state of the world is to compromise the foundations of national freedom and independence.

Winston Churchill

Overview

Accomplishing a review of literature achieves two purposes. First and foremost, this allows one to become familiar with available material. Second, this review provides any follow-on researchers with a short synopsis of the variety of information related to this topic. The review of literature for this project consisted of books, government publications, journals, and news articles. The author examined, compared, and contrasted information from these sources to determine relevancy to the topic. The following are brief reviews of a few of the significant reference materials.

"Strategic Airlift: Our Achilles Heel"

There are numerous official government reports, research papers, and news articles chronicling the shortfall of intertheater airlift within the USAF. Most solutions focus efforts towards purchasing additional military-style aircraft, solving maintenance problems in the current fleet, or upgrading older airframes. Lieutenant Colonel John C. Burns' Army War College research paper "Strategic Airlift: Our Achilles Heel" examines the purpose, components, and capabilities of the national airlift system. He shows there is an airlift shortfall and recommends additional C-17 procurement and partial upgrade to the C-5 fleet as the most cost-effective solution (Burns 2001). Lieutenant Colonel John Burns' assessment is in line with the trend to stay the course, solely relying on equipping

DoD with traditional military-style aircraft to solve the United States' intertheater airlift shortfall.

Mobility Requirements Study FY2005

The *Mobility Requirements Study FY2005* examined the number and mix of mobility systems DoD required. Released in 2000, this report updated the 1995 *Mobility Requirements Study Bottom-Up Review Update*. While the ability to prosecute two nearly simultaneous major theater wars remained the foundation of national military strategy, this report recognized DoD's increasing focus on small-scale contingencies, peacetime presence and engagement missions, and threats from weapons of mass destruction. These new focus areas, combined with the changes in the international environment, military force structure, and asymmetric threats to airlift forces, complicate planning and have implications to the United States' ability to project its military forces. Using projected deployment models and airlift forces, this study attempted to define DoD's mobility and airlift requirements for FY2005. After reviewing a range of demands, the *Mobility Requirements Study FY2005* identified the need for an airlift capability from 51.1 MTM/D to 67.0 MTM/D. Three high priority missions--conducting special operations, deploying missile defense systems to friendly nations, and supporting other theater commanders not directly engaged--determined the moderate-risk requirement of 54.5 MTM/D (DoD 2001b, 4).

The *Mobility Requirements Study FY2005* predicted DoD's airlift capability would only be 48.3 MTM/D. This figure assumed a fleet of 120 C-17s, a 65 percent mission capable rate for the C-5 fleet, and a CRAF contribution of 20.5 MTM/D (DoD 2001b, 5). To correct this deficiency and develop an airlift capability between 51.1

MTM/D and 54.5 MTM/D, this study recommended DoD consider improving and enhancing the C-5 fleet, increasing the size of the C-17 fleet to 126 to 176 aircraft (based on the C-5 modernization program implemented), and using additional services that could be provided by CRAF operators (DoD 2001b, 4-6).

Air Mobility Strategic Plan 2002 Update

Congress tasked DoD to determine future mobility requirements for the armed forces and to develop an integrated mobility plan. The *Air Mobility Strategic Plan 2002 Update* took into account a number of interrelated factors including potential threats, warning time, allied participation, overseas bases, access rights, and availability of commercial aircraft. This report acknowledges the USAF has developed an air mobility capacity unmatched in military history, but requires improvements to meet current and future Joint Chiefs of Staff requirements. This report's proposed solution included a combination of procuring additional C-17 aircraft (increase the current programmed number of 180 to 222) and increasing the mission capability rates in the C-5 fleet (AMC 2002, 63).

The *Air Mobility Strategic Plan 2002 Update* also attempted to predict the security environment, as well as assess significant political, economic, and social trends, over the next twenty-five years. It describes a possible future environment, based on the following guidance: (1) *National Security Strategy*, (2) *National Military Strategy*, (3) *Defense Planning Guidance*, (4) *New World Coming*, (5) *United States Commission on National Security*, (6) *Global Engagement, A Vision For 21st Century Air Force*, and (7) *Air Force Strategic Plan* (AMC 2002, 9).

Yogi Berra used to say that prediction is very hard, especially when it is about the future. Still, this study's assessment is important because it established assumptions, priorities, and future roadmaps the USAF will use to determine its future intertheater airlift mobility force structure. This key-planning document made several predictions. First, the airlift mobility forces already high peacetime operations tempo will continue and there will be increased demands to support smaller-scale contingencies. Second, the airlift mobility force is susceptible to weapons of mass destruction attacks and will encounter different and deadlier forms of attacks in the future. And third, success will rely on greater commonality with the commercial sector (AMC 2002, i).

Because AMC's structure is based on wartime requirements, the resources it has available for peacetime operations are limited. To respond to increasing peacetime demands, AMC has relied on volunteerism of the Air Reserve Component and the CRAF. This has placed increasing demands on the active duty force, which has affected personnel retention and aircraft mission capable rates (AMC 2002, 22). These peacetime demands are not likely to subside. For instance, due to massing of populations in developing countries, there exists an increasing potential for a large-scale natural or man-made disaster that would require mobility forces for humanitarian operations (AMC 2002, 20). To meet future needs, the *Air Mobility Strategic Plan 2002 Update* recommends analysis be conducted to determine ways to make greater resources available to the air mobility system during peacetime (AMC 2002, 22).

AMC's intertheater airlift forces will certainly face a wide range of dangers including conventional, unconventional, terrorism, environmental, and potentially weapons of mass destruction. These threats may not come only from recognizable state

actors, but also from non-state groups that do not have clearly identifiable borders or sources of funding. This greatly complicates the future environment since adversaries will increasingly attempt to stall or deny air mobility forces access to certain regions (AMC 2002, 21).

This anti-access strategy could include man-portable air defense systems, small arms fire, or chemical attacks on aerial ports since the most vulnerable phase of air mobility missions today is in the terminal area during takeoff and landing (AMC 2002, 24). Even more difficult to predict is how advanced technology will be incorporated into future weapons. Kinetic energy kill capabilities, advanced radiation and microwave weapons, and high-energy lasers are just some of the developing technologies that may influence the weapons of tomorrow. With such an uncertain environment, force protection, intelligence, and defensive systems will be indispensable for future airlift aircraft to remain effective and survive.

The *Air Mobility Strategic Plan 2002 Update* states, "By promoting greater compatibility with commercial systems and procedures, while still meeting military requirements, future opportunities for cost savings and commercial augmentation of the MAF [Mobility Airlift Forces] will be enhanced greatly" (AMC 2002, 25). The focus of this statement was towards solving the incompatibility between the military 463L pallets and the commercial International Standards Organization container cargo handling systems. This incompatibility inevitably induces delays when military cargo is transshipped between military and commercial air, ground, and sea cargo systems.

The Missile Threat to Civil Aviation

RAND's *The Missile Threat to Civil Aviation* highlights the man-portable missile threat to civil aviation around the world. Written prior to the start of America's Global War on Terrorism, this work highlights the man-portable missile threat; evolution of missile technology and defensive countermeasures; and, suggests possible solutions to reduce large, multi-engine civil aircraft vulnerability.

Since the fielding of heat-seeking man-portable missiles in the late 1960s, there have been a significant number of attempts to down large civil passenger aircraft. The historical record indicates shooting down an aircraft is less likely than airport bombings, hijacking, or attacks on aircraft. Nevertheless, successful attacks have been occurring at "rates of up to 1 or 2 a year for more than 20 years and cannot be ignored" (Schaffer 1997, 1). Most of these attacks occurred where active fighting was underway. Typically, a successful attack kills about 19 civilians (Schaffer 1997, 4). Although missile-related terrorist incidents represent only a small fraction of terrorist acts, they can result in great loss of life. It is RAND's belief that man-portable missile systems will remain a threat to civil aircraft.

The first thing to know about man-portable missiles is there are hundreds of thousands of them in arsenals around the world. In 1997, fifty-six countries were known to be in possession of SA-7 missiles alone. Twenty-one countries owned Stinger missiles. The SA-14 had been exported to thirty-two countries, the SA-16 to forty-one countries, and another four countries possessed the SA-18. More than 100,000 SA-7 and SA-14 missiles were exported by Russia, and some 9,000 Stinger variations by the United States (Schaffer 1997, 2-3).

With such large quantity of exports to so many different countries, it is not surprising that man-portable missiles have found their way into the hands of terrorist groups. These organizations simply purchase excess weapons from governments and other groups in need of currency. Some well-financed terrorists have demonstrated a willingness to pay top dollar for the best technology. Others have opted for the cheapest available. To put the threat in perspective, in 1997 at least seventeen terrorist or insurgency groups were known to possess man-portable missile systems (Schaffer 1997, 3).

Man-portable missile systems have steadily improved since their introduction in 1965. Early systems (Redeye and SA-7) detected solar reflections and hot metal and were marginal in their target discrimination, range, altitude, and maneuverability. As an example, the SA-7 suffers from unreliable fusing; is susceptible to counter measures; may track sun glare; and is limited to only tail chases from a relatively small engagement envelope. The next generation (Stinger and SA-14/16) used cooled indium/antimony elements to detect hot metal and engine exhaust. The third generation (Stinger POST/RMP, SA-18, and Keiko II) uses dual-band seeker elements or a focal-plane-array and have the capability to engage targets at altitudes up to 20,000 feet, at great speed, and from any direction. No longer do modern man-portable missile systems require an aircraft's hot engines or exhaust to guide them to their target. Furthermore, these systems are resistant to flare and laser countermeasures (Schaffer 1997, 4-5).

So how can you prevent missile engagements of civil aircraft? RAND suggests a number of passive and active countermeasures. Some are relatively inexpensive but only partially effective. The most effective active countermeasure is a missile warning system

plus a laser jammer. This system would cost approximately \$2 billion to install on the entire United States' wide body commercial fleet. The least effective passive countermeasure system might cost one hundred times less than that, or about \$20 million (Schaffer 1997, 7-8). Until a man-portable missile impact study is conducted on commercial aircraft, the most cost effective system will not be known.

RAND suggests the following passive countermeasures: infrared signature reduction, offset decoys, fuel tank inerting, and redundant flight controls. Infrared signature reduction techniques are among the least expensive countermeasures and have a proven record in military aircraft. Once an understanding of where missile impacts might occur, engineers can reduce or alter an aircraft's infrared image. This could include shielding, special paints, and a mixture of cold air stream with hot engine exhaust gases. The Israeli Air Force used offset decoys on A-4 aircraft in the 1970s to alter their signature. This method may be less expensive and objectionable than flares since nothing ejects from the aircraft. A number of schemes to reduce the potential for explosion and fire in fuel tanks have been developed. These include adding reticulated foam, using self-sealing bladders, or inerting the tank with a nitrogen atmosphere. These not only help against missile threats, but also offer a safety advantage against other accidental ignition sources. Finally, a proven way to minimize the effects of a missile strike is to utilize redundant and separated controls. Since most commercial aircraft depend on common data bus wiring, a critically located explosion could potentially destroy all their avionics. With the digital avionics used today, there is an opportunity to design effective redundancy (Schaffer 1997, 8).

Active systems include the Advanced Threat Infrared Countermeasures (ATIRCMS), the Directed Infrared Countermeasure System (DIRCM), and chemical flares. ATIRCMS includes a missile warning system, a xenon lamp to jam high-frequency/low wavelength threats, and a solid-state laser to jam infrared threats. This system has several drawbacks including cost (approximately \$1 million per copy), weight, and the potential for blinding injuries due to the low powered laser. Despite this, development tests have shown this system is the most effective countermeasure against man-portable missiles, including the most recent designs. DIRCM offers a less effective level of protection, but costs considerably less than ATIRCMS. Instead of a laser, this system uses an upgraded xenon lamp to jam missile seekers. It performs well against early-generation infrared missiles, but is ineffective against the latest generation. Flares are another possibility, but their effectiveness is limited to early-generation infrared missiles since later systems have logic to filter out their images (Schaffer 1997, 8-9).

Another interesting possible solution RAND poses is developing an international agreement preventing the blatant use of civilian aircraft to ferry troops or materials into theaters of conflict. If it is required that such an aircraft be recommissioned and repainted as a military aircraft, it is less likely that commercial aircraft in the vicinity would be attacked (Schaffer 1997, 10).

C-17 Aircraft, Cost and Performance Issues

The United States General Accounting Office released a report entitled *C-17 Aircraft, Cost and Performance Issues* in 1995. This report examined whether the C-17 was the most cost effective aircraft to meet DoD's intertheater airlift requirements. Prior to this report, DoD explored alternatives to a 120 aircraft C-17 program by considering

complementary mixes of other aircraft. Alternatives examined included restarting the C-5 line, extending the service life of the C-141, and procuring modified commercial freighter aircraft. DoD study's preferred choice was a fleet of 120 C-17s based on throughput (tons of cargo delivered in a given period), even though this option was more expensive than a mixed fleet of C-17s and modified commercial freighters.

DoD based their conclusion on three major assumptions. First, airfield availability would be constrained to Operation Desert Shield levels. Second, the C-17 would achieve a 15.2-hour a day utilization rate while commercial freighters would achieve only a 12.5-hour a day rate. Third, the C-17 would routinely accomplish intratheater airlift missions and thus, C-130 operating and support costs should be added to non-C-17 alternatives (United States, General Accounting Office 1995, 22). The United States General Accounting Office report refuted DoD's conclusions. Although this report has several flaws documenting deficiencies in the C-17 program, their conclusion that a mixed fleet of 40 C-17s and 64 modified commercial Boeing 747 cargo freighters could meet the requirements of the *Mobility Requirements Study* at a substantial cost savings of \$10.7 billion (in constant year 1993 dollars) is interesting and worthy of further research (United States, General Accounting Office 1995, 3).

Strategic Airlift Force Mix Analysis

The AMC Analysis Group completed a tailored cost and operational effectiveness analysis of an integrated C-17 and Non-Developmental Airlift Aircraft (NDAA). The *Strategic Airlift Force Mix Analysis* investigated the cost effectiveness of a mixed fleet of military and NDAA (Boeing 747-400F Cargo Freighters referred to by the military designation of C-33) with the equivalent capability of 120 or 140 C-17s. This study was

not a requirements analysis, nor did it consider mixes of additional military-style aircraft, a service life extension for the C-141, nor options of purchasing different Boeing 747 variants. Force mix alternatives evaluated against a fleet of 120 C-17s/no NDAA included 100 C-17s/18 NDAA and 86 C-17s/30 NDAA (AMC, Analysis Group 1995, 3-5).

Using the threat and scenario assumptions published in the *Mobility Requirements Study Bottom Up Review Update*, this study attempted to provide senior decision makers on the Defense Acquisition Board a recommendation of the type and number of NDAA that would complement or supplement a fleet of C-17s. The mix of 86 C-17s/30 NDAA was determined as the most cost effective of the alternatives. However, this force mix did not satisfy tactical objectives to airdrop an Army brigade (120 C-17s and 50 C-5s required), lesser regional contingencies (100 or more C-17s required), or additive intratheater airlift requirements (136 C-17s required). The study further determined the 100 C-17/18 NDAA option was the most cost-effective solution that provided both intertheater airlift and tactical utility. The Defense Acquisition Board made the decision to increase the purchase of C-17s to 120 aircraft without additional supplementation of modified Boeing 747-400Fs (AMC, Analysis Group 1995, 13-14).

In the head-to-head C-17 versus Boeing 747 comparison, the Boeing 747 enjoyed a number of advantages. It had a lower purchase price and did not require aerial refueling to fly nonstop halfway around the world, whereas the C-17 needed several refuelings. The Boeing 747 also had a major drawback: It could not operate from austere or short landing strips. In addition, it could not carry outsize cargo, such as tanks, Patriot missile

systems, and other large items that would be critical in the early days of a war. The Boeing 747 also lacked a roll-on and roll-off capability.

Finally, the Defense Acquisition Board determined the use of a Boeing 747 could diminish the business available for the airlines participating in the CRAF program. That, in turn might have caused some CRAF participants to withdraw, drastically cutting the overall lift available in wartime.

*Finding the Right Mix of Military and Civil Airlift,
Issues and Implications*

In 1994 RAND also researched the optimum mix of commercial and military airlift that could meet intertheater airlift requirements for the least cost in their report *Finding the Right Mix of Military and Civil Airlift, Issues and Implications*. The USAF sought an independent estimate of the correct mix because the cost of maintaining the nation's airlift capabilities is very sensitive to choices about the mix of commercial and military airlift and to choices about the quantities and types of aircraft owned and operated by the United States military. In addition, major investments like intertheater airlift aircraft have a significant and long lasting implication on future capabilities. This study looked at military-style aircraft like the C-17 and concluded they offer the most flexibility. This study also looked at commercial-style aircraft and concluded they offer the least costly approach to delivering passenger and small items of cargo to airports with well-established facilities. RAND's analysis of alternative airlift fleets showed almost a four-to-one cost effectiveness ratio advantage for a civil-style transport, such as the Boeing 747-400F, over the C-17 for the movement of bulk cargo (RAND 1994).

"The Airlift System: A Primer"

Lieutenant Colonel Robert Owen's article in the *Air Power Journal* entitled "The Airlift System: A Primer" is a revealing macro level introduction into how the USAF's complex airlift system works. He argues that airlift planners face three noteworthy tensions--high demand, fleet structure, and budget. To begin with, planners face an expensive reality that no matter how much capacity they create, there is always demand for more. Owens states, "Although overall US long-range airlift capacity has grown more than twentyfold since the early 1950s, the relative gap between airlift requirements and capabilities seems hardly to have narrowed" (Owen 1995, 19).

As airlift gained capability, each service became more and more reliant on it to meet logistic requirements. No single aircraft can efficiently transport every type of cargo, over every route, into every possible airfield. An efficient airlift fleet, therefore, must be composed of several types of aircraft. Determining the optimum mix is a daunting task with long-term consequences. The high cost of aircraft presents planners with the additional frustration of knowing they will never acquire a fleet large and diversified enough to transport all possible requirements with maximum efficiency. Realistically, no long-term airlift plan is likely to withstand the tests of changing national strategies and growing user requirements. These three tensions impose constraints on the process of formulating airlift policy. Thus, the focus is not to build an airlift fleet to satisfy a specific requirement; rather, "acquire the largest and most generally capable airlift with the funds available" (Owen 1995, 20).

Owen also describes two tenets of airlift policy. He states the central tenet is "the commercial airline fleet is the heart of the national airlift fleet" (Owen 1995, 21). The

wisdom of relying on the CRAF is well established in national policy. In 1955, the Hoover Commission report on government airlift operations declared purchasing military transport aircraft to carry loads that could be carried on commercial airliners as "military socialism." President Reagan's Airlift Policy Directive of 1987 restated the usefulness of using civil air carriers to the maximum extent possible during both peacetime and war. The reason is simple. A strong commercial fleet should always be available without burdening the government with the day-to-day overhead costs.

The second tenet Owen states is the "role of the military component of the airlift fleet is to do what commercial transport aircraft or civilian aircrews cannot or will not do" (Owen 1995, 23). President Reagan's national airlift policy mandated DoD to "determine which airlift requirements must move in military airlift manned and operated by military crews because of special military considerations, security, or because of limiting physical characteristics such as size, density, or dangerous properties; and which airlift requirements can be appropriately fulfilled by commercial air carriers" (United States, President 1987). These missions could include critical airlift during the initial stages of an emergency, classified or diplomatically sensitive missions, or operations into airfields not suitable or too dangerous for civilian crews and aircraft. Since most war plans include these types of missions, there is a place for the military component of the national airlift fleet. Its size and composition should be based on supplementing civil air carriers, not on preempting their role (Owen 1995, 23).

CHAPTER 3

RESEARCH METHODOLOGY

Often it is the non-lethal application of air mobility that contributes most effectively towards achieving national security objectives.

Air Force Doctrine Statement 2-6

Overview

This chapter examines the research methodology used to determine the feasibility of commercial-style aircraft solving DoD's intertheater airlift shortfall. Using the methodology outlined here, Chapter 4 researches, defines, and analyzes the following subjects: (1) the components of the strategic mobility system, (2) the purpose of the national airlift system, (3) the current environment intertheater airlift forces operate in, (4) DoD's intertheater airlift requirements, (5) the benefits of using military-style versus commercial-style intertheater airlift aircraft, and finally (6) an analysis of military and commercial intertheater airlift procurement and operating costs.

Strategic Mobility Structure

The first task is to define the national strategic mobility structure and demonstrate how each portion complements the others. The components of the national strategic structure include airlift, sealift, and pre-positioned equipment. This section also lists planning factors DoD uses to determine which elements of the national strategic structure will respond to a crisis. By understanding the benefits and drawbacks of each leg of the mobility triad structure, planners can best utilize the most appropriate method to transport personnel and cargo to the right place, at the right time.

National Airlift Policy

In order to gain an appreciation for the intertheater airlift shortfall, one must first understand the elements of the national airlift system. The author describes the purpose of this system and examines national policy guidance. At the heart of this system is the ability of the United States to balance its organic military intertheater airlift fleet with contracted CRAF assets. To allow the reader to understand the national airlift system, the author describes the components and demonstrates how each has a valid role. The author examines past decisions made by political and military leaders to separate military and commercial roles. This unique partnership has involved both confrontation as well as cooperation, as each competed for their share of DoD's airlift market. Of particular concern is the policy issue of who should transport military cargo and passengers during peacetime. Finally, the author demonstrates how the national airlift policy concerning force structure planning is confusing and thus, inadequate for the current strategic environment.

Intertheater Airlift Requirements

One of the difficult aspects of mobility force structure planning is determining exact requirements. So what are DoD's intertheater airlift requirements and is there a shortfall in capability? To answer these questions, the author examines how DoD determines mobility requirements. By reviewing airlift requirement studies since 1981, the author defines DoD's intertheater airlift requirements and demonstrates how there has not been enough intertheater airlift capability to meet national requirements. The author will also show how leaders tailored intertheater airlift force requirements and structure to meet budgetary and political constraints, rather than actual requirements. The author will

then question the validity of these mobility studies' assertions. By using examples of intertheater airlift used during Operation Desert Shield and Desert Storm, the author will examine whether mobility studies accurately reflect utilization rates and average payload planning factors.

Current Intertheater Airlift Operating Environment

The author will explore the evolution of the airlift partnership between the military and contracted civil air carriers. Due to overwhelming costs of maintaining a fully capable organic military intertheater airlift fleet, the nation gradually shifted its airlift capacity to the CRAF. Since the creation of the CRAF in the 1950s, the structure of the national airlift system has revolved around a Cold War strategy, with the United States doing little to update its airlift policy to meet current demands.

This section will analyze and outline significant changes DoD now faces. These include increased demands to support MOOTW missions in addition to wartime demands, reduction in defense spending and forward basing, and increased threats to both military and CRAF intertheater airlift assets by non-state actors. Even though the national airlift system has worked well in the past, the author will highlight friction points between the military and commercial sectors. These problems include CRAF carriers operating in high threat environments under the threat of surface-to-air-missiles and chemical attacks, loss of revenue and market share, and the United States civil air carrier industry procuring fewer large aircraft, instead favoring smaller aircraft that offer greater scheduling flexibility.

Military Intertheater Airlift Cargo Requirements

This section provides a historical overview of DoD's intertheater airlift requirements. The author details past Cold War requirements and compares them to current requirements. With the reduction in percentage of oversize cargo, DoD now has an opportunity to rethink its composition of intertheater airlift aircraft. Specifically, matching airfields and cargo loads to appropriate airlift aircraft can increase operating efficiency.

Military Versus Commercial Intertheater Airlift Aircraft Benefits

This section explores the unique characteristics that both military-style and commercial-style intertheater airlift aircraft possess. The author uses the current mobility requirements study to demonstrate the CRAF's critical importance by highlighting DoD's absolute reliance on this capability. A capability comprised completely of commercial-style intertheater airlift aircraft that fulfill military requirements.

The author will also illustrate the distinguishing features of military-style and commercial-style aircraft. The benefits and liabilities of both of these styles of aircraft will be explained, including the military requirements for flexible aircraft versus commercial requirements for economically efficient aircraft. Each type of aircraft offer distinct advantages, that when combined, provided the nation its global reach.

In addition, the author further defines flexibility beyond just satisfying special intertheater airlift requirements. Total quantity of aircraft also effects flexibility. Reduce the number of aircraft available, and less locations can be serviced. Avionics packages also allow flexibility when operating in a tactical environment or in the world's instrument air route systems.

Military and Commercial Intertheater Airlift
Procurement and Operating Costs

This section will analyze the procurement and operating costs of a C-17 versus a Boeing 767-300F. The author will analyze DoD and Department of Transportation data and planning factors to establish the cost of procuring and operating each of these aircraft. Logistics cost factors include individual aircraft purchase price, supplies, fuel, oil, and organic maintenance and repair, but does not include any contractor logistic support costs.

CHAPTER 4

ANALYSIS

The most important thing is to have a flexible approach. . . . The truth is no one knows exactly what air fighting will be like in the future. We can't say anything will stay as it is, but we also can't be certain the future will conform to particular theories, which so often, between the wars, have proved wrong.

Brigadier General Robin Olds

Overview

This chapter analyzes the feasibility of commercial-style aircraft solving DoD's intertheater airlift shortfall. The author begins with an overview of the structure of mobility forces and the national airlift system. Within this framework, the current environment airlift forces are expected to operate in and the United States' cargo requirements will be described. The chapter will conclude by analyzing the pros and cons of military-style intertheater airlift aircraft versus commercial-style intertheater airlift aircraft, including procurement and operating costs.

Mobility Triad Structure

The strategic mobility triad is comprised of three legs--airlift, sealift, and pre-positioned equipment. Each leg of the triad depends on the others since each has inherent strengths and weaknesses. Airlift provides speed and flexibility but has limited capacity and greater costs. Sealift can move tremendous amounts of materiel at a reasonable cost but is slow and requires well-developed ports to discharge cargo. Since there are limited suitable modern ports around the world, sealift delivery may occur a significant distance from where supplies and equipment are actually needed. Thus, additional truck, rail, or airlift requirements might be required to complete delivery. Airlift's flexibility, on the

other hand, may permit use of an aerial port of debarkation (APOD) closer to the desired destination, thereby reducing additional transportation requirements.

Pre-positioning, composed of the afloat pre-positioning force and land-based pre-positioned equipment, combines the speed of airlift with the bulk of sealift. The advantage provided by the size of the ships in the afloat pre-positioning force can also be a disadvantage since large ships are restricted to the availability of appropriate ports. In addition, the amount of equipment these ships carry must be taken into account; the space needed for reception, staging, onward movement, and integration is immense.

Land-based pre-positioning programs are maintained in Europe, Southwest Asia, Korea, and the Pacific. The problem with land-based pre-positioned stocks is that they are difficult to move to other geographic locations and are vulnerable to seizure or destruction by hostile forces. Furthermore, whether on land or at sea, pre-positioned material must be constantly maintained and upgraded to ensure compatibility with current force capabilities.

USTRANSCOM is the functional unified command designated as DoD's single manager for land transportation within the CONUS and has global responsibility to support combatant commander's air and sea transportation requests. USTRANSCOM integrates transportation resources while its three service components--AMC, Surface Deployment and Distribution Command (SDDC), and Military Sealift Command (MSC)--execute the operations.

Determining the appropriate mode of transportation is a difficult and complex task because planning factors rarely remain static. Changing political priorities, national security strategy, geographic combatant commander's requirements, new technologies,

and other planning factors such as time, distance, load configurations, diplomatic country clearances, en route facilities, and port of embarkation and debarkation all greatly influence the mode of transportation. Regardless of the process, today's smaller CONUS-based force and most government agencies rely increasingly on airlift as its preferred crisis response mechanism (Owen 1995, 4).

As USTRANSCOM's air component, AMC is responsible for developing, managing, coordinating, and employing airlift and tanker assets. In addition to its own airlift forces, AMC regularly coordinates with AFRC, ANG, Air Force Special Operations Command (AFSOC), United States Air Forces Europe (USAFE), Pacific Air Forces (PACAF), and other Major Commands that operate and maintain air mobility platforms. AMC's primary command and control agency for airlift and tanker assets is TACC. Using the principle of centralized control and decentralized execution; TACC plans, schedules, tasks, and is the execution agency for all operations involving AMC. TACC further evaluates each airlift tasking and determines the proper mix of military and CRAF aircraft it will schedule to accomplish the mission.

Besides utilizing the CRAF, AMC relies upon their Reserve Components to reduce operating costs. According to General Charles "Tony" Robertson, AMC relies on the ANG and AFRC to provide 57 percent of airlift assets including approximately 60 percent of airlift aircrews, 54 percent of the tanker aircrews, and 55 percent of the entire maintenance force (AMC 1997, 3-9).

Other organizations that accomplish functions for AMC include Air Mobility Operations Control Centers (AMOCCs), Expeditionary Mobility Task Forces (EMTFs), wings and groups, and Air Mobility Operations Groups (AMOGs). AMOCCs are theater-

assigned organizations that provide functions similar to TACC, but for theater-assigned mobility forces. Both the 15th and 21st EMTFs were reorganized on 1 October 2003 as AMC's warfighting components responsible for organizing and providing mission ready airlift forces. Each EMTF aid in their subordinate unit's assessment, training, evaluation, communications, and force management to ensure AMC's forces remain mission ready.

AMC wings and groups consist of airlift and tanker resources. The active duty currently has twelve wings and seven groups. In addition, twenty-seven AFRC and thirty-eight ANG wings round out AMC's air mobility forces (AMC 2002, 61). Air mobility operations also require an en route system of support personnel and infrastructure to ensure aircraft are maintained, crews are rested, and passengers and cargo are properly handled. AMOGs provide these valuable services. AMOG Air Mobility Liaison Officers also deploy with United States Army units to serve as mobility experts.

National Airlift System

President Reagan captured the purpose of the national airlift system: "The national defense airlift objective is to ensure that military and civilian airlift resources will be able to meet defense mobilization and deployment requirements in support of U.S. defense and foreign policies" (United States, President 1987). Based on compromise, the national airlift system is comprised of military and commercial facilities, equipment, and personnel. This partnership, unique from other military arms, has lasted more than six decades (Crackel 1998, 29). At the heart of this system is the ability of the United States to balance the commercial aviation industry's economic efficiency with its own specialized military flexibility. Neither can independently satisfy the nation's intertheater airlift requirements alone, thus, both are vital national resources.

Implemented and updated throughout the Cold War, the nation's airlift policy stressed increasing the number of aerial ports and pre-positioning overseas to increase the efficiency of the en route structure (Military Airlift Command 1991, 145). President Reagan reemphasized the nation's commitment to a robust national airlift fleet with *National Security Decision Directive 280*. This directive's broad purpose was to provide a framework for the private and public sectors to implement in order to meet established government requirements. This policy recognized military and commercial resources as important and interdependent in the fulfillment of national objectives. To protect commercial industry, *National Security Decision Directive 280* emphasized the commercial sector and directed minimum use of military assets to what was necessary to maintain operations and training (United States, President 1987). Toward this end, the national airlift policy established the following policy guidelines:

1. United States policies shall be designed to strengthen and improve the organic airlift capability of the Department of Defense and, where appropriate, enhance the mobilization base of the U.S. commercial air carrier industry.
2. The goal of the United States Government is to maintain in peacetime organic military airlift resources, manned, equipped, trained and operated to ensure the capability to meet approved requirements for military airlift in wartime, contingencies, and emergencies. Minimum utilization rates shall be established within the Department of Defense which will provide for levels of operation and training sufficient to realize this goal.
3. The Department of Defense shall determine which airlift requirements must move in military airlift manned and operated by military crews because of special military considerations, security, or because of limiting physical characteristics such as size, density, or dangerous properties; and which airlift requirements can be appropriately fulfilled by commercial air carriers.
4. The commercial air carrier industry will be relied upon to provide the airlift capability required beyond that available in the organic military airlift fleet. It is therefore the policy of the United States to recognize the interdependence of military and civilian airlift capabilities in meeting wartime airlift requirements,

and to protect those national security interests contained within the commercial air carrier industry. (United States, President 1987)

The national airlift system's partnership has involved both confrontation as well as cooperation. Comprised of both government and private groups, at times each has pursued their own goals and interests. At the forefront is the policy issue of who should transport military cargo and passengers during peacetime. Military proponents claim peacetime transportation on DoD's organic assets is a cost effective by-product of the need to train and exercise the military's wartime mission. Commercial proponents claim that this constitutes unfair competition and civil air carriers should transport most of the military personnel and cargo since they are more efficient than the military. Current policy attempts to reduce this tension by stating:

During peacetime, Department of Defense regulations for passenger and/or cargo airlift augmentation shall be satisfied by the procurement of airlift from commercial air carriers participating in the Civil Reserve Air Fleet Program, to the extent that the Department of Defense determines that such airlift is suitable and responsive to the military requirement. (United States, President 1987)

Previous policy defined the United States' airlift objectives, but failed to answer several key questions. Should the national airlift system prepare primarily for peacetime or war? Should the national airlift system optimize for peak efficiency or maximum effectiveness? *National Security Decision Directive 280* attempted to answer these critical questions by simply saying "yes" to everything. America should develop "efficiently and effectively to meet established requirements for airlift in both peacetime and in the event of crisis or war" (United States, President 1987). This policy guidance concerning force structure planning can be confusing because the most effective wartime airlift force could quite possibly be the most inefficient in peacetime, as well as during war.

Intertheater Airlift Requirements

One of the difficult aspects of mobility force structure planning is determining exact requirements. Since 1981, every mobility requirement study has concluded there is simply not intertheater airlift capability to meet national requirements. Instead, national leaders have tailored the intertheater airlift force structure to meet budgetary and political constraints, instead of what requirements dictate.

Faced with the security risks of increased build up of Soviet forces in Eastern Europe and an unstable Middle East, in 1981 Congress required DoD to examine their mobility requirements. The *Congressionally Mandated Mobility Study* evaluated DoD airlift requirements against DoD's proposed 1986 requirements and force structure. This study recommended a minimum of 66 MTM/D of airlift to meet wartime planning scenarios, an amount well above MAC's existing capability (Military Airlift Command 1991, 175). This figure, however, did not represent DoD's true airlift requirement since the least demanding scenario studied required 83 MTM/D of airlift capacity (Miller 1988, 373). To Congress, this amount of airlift was too far beyond fiscal reality. Instead, the *Congressionally Mandated Mobility Study*'s recommendation was based upon what was deemed affordable, rather than what was required to achieve national security objectives. Nevertheless, the 66 MTM/D figure, although never achieved, became the mainstay of airlift requirements throughout the Cold War.

After the fall of the Soviet Union, there was a need to reexamine national mobility requirements. The 1991 Defense Authorization Act tasked DoD to analyze future mobility requirements and develop an integrated mobility plan (DoD 1992, ES-1). The *Mobility Requirements Study* examined airlift requirements against DoD's proposed 1999

requirements and force structure. Without the Cold War Soviet threat, forward deployed forces could now be used instead of just CONUS-based forces. This reduced DoD's mobility requirements to 57 MTM/D (DoD 1992, IV-5). Unfortunately, this minimum recommendation again fell short of MAC's airlift capabilities at the time, but was deemed fiscally acceptable. The study also warned their mobility capability recommendation might not be adequate to support national security objectives in some worst-case scenarios (DoD 1992, ES-4).

The *Mobility Requirements Study Bottom Up Review Update*, completed in 1995, once again examined mobility requirements against DoD's proposed 2001 requirements and force structure (DoD 1995, ES-1). Fully aware of DoD cutbacks and personnel drawdown, this study examined three war-fighting phases and determined airlift's speed and flexibility was essential to supporting United States' national security objectives. Sealift "could not arrive in time to affect the halting phase of the fight" (DoD 1995, ES-2). Therefore, a robust airlift capability was deemed essential for the time-critical opening phase of a crisis. Once again succumbing to fiscal pressures, the *Mobility Requirements Study Bottom Up Review Update* recommended a moderate cost solution to mobility requirements and lowered the airlift requirement to between 49.4 and 51.8 MTM/D (DoD 1995, ES-6). After analyzing the Army's ability to preposition equipment and supplies, DoD set their airlift target at 49.7 MTM/D (AMC 1997, 2-29).

The *Mobility Requirements Study FY2005*, released in 2001, is the latest document to establish intertheater airlift requirements. The Joint Staff, Office of the Secretary of Defense, USTRANSCOM, and AMC undertook this study. The *Mobility Requirements Study FY2005* was largely based on diminished airlift requirements then

considered adequate for the post-Cold War world. This study established a new minimum strategic airlift requirement of 54.5 million-ton miles per day but acknowledged that during the early stages of a major theater conflict, that requirement could surge to 67 million-ton miles per day (DoD 2001b, 4). This study noted that DoD's airlift fleet was insufficient for known requirements and it further stated that wartime needs could be met only with a high degree of risk.

The USTRANSCOM commander, General John Handy, views the *Mobility Requirements Study FY2005* as a historical document given the terrorist attacks that occurred on 11 September 2001, the establishment of new combatant commands, and the requirements generated by the ensuing combat operations in Afghanistan and Iraq. General Handy said about the *Mobility Requirements Study FY2005*, "It was a good study for its time but it's also a lesson in that in spite of how well you think you do a study--and that was for 2005--we're not there yet, we see the world has changed dramatically." He further indicated the follow-up to the *Mobility Requirements Study 2005* will likely set metrics based on scenarios instead of a specific time frame to ensure planning is not overtaken by events (Cortes 2003, 6). General Handy wants AMC to conduct a new requirements review right away, "while the lessons [of Operation Iraqi Freedom] are all very hot on people's minds" and supporting data are readily available. He further stated, "We need to look at the assumptions in MRS-05 [*Mobility Requirements Study FY2005*] and update it" (Tirpak 2003, 25).

The TACC commander, Major General Edward L. LaFountaine, also indicated AMC's responsibilities have surged since the terrorist attacks on 11 September 2001. Prior to the attacks, TACC was running about 250 to 260 missions per day. In the

immediate aftermath of the attacks, the number hit a new plateau in the high 400s and even spiked above 500 missions per day in fall 2001. When the war in Afghanistan slowed down, the airlift fleet settled back to a new level in the mid-300s per day. In Operation Iraqi Freedom, missions run by AMC increased to a peak of 460 a day, not including activities of military intertheater airlift aircraft temporarily assigned to Central Command. These figures included missions flown by the commercial aircraft of the CRAF (Tirpak 2003, 25).

The number of missions flown does not fully convey the extent of AMC's workload. Air Combat Command, for example, determines its level of activity by a sortie standard, with each combination of a takeoff and a landing counting as a single sortie. AMC determines its activity not by sortie, but by mission. Completion of a single mission often requires several takeoffs and landings, and thus potentially numerous sorties over a period of days. Using Major General LaFountaine's calculation of "about a three-to-one multiple of sorties to missions," one can get an appreciation of AMC's workload since 11 September 2001 (Tirpak 2003, 25).

The *Air Mobility Strategic Plan 2002 Update* assesses AMC's combined organic military and contracted CRAF intertheater airlift capacity at 46.07 MTM/D (AMC 2002, 64), which falls significantly short of meeting the United States' requirements for even moderate risk demands. To meet future demands, AMC must accelerate its intertheater airlift transformation if it is to meet the new force projection benchmark set by former Army Chief of Staff General Shinseki of deploying one brigade anywhere in the world within 96 hours and one division within 120 hours (United States Army 2002, 16). Bottom line, with so many critical requirements, AMC simply does not possess sufficient

intertheater airlift assets to accomplish the goals and objectives of the current United States' national military strategy of engagement. Since the airlift portion of the strategic mobility triad represents the cornerstone of national security, the United States can ill afford to ignore this critical shortfall.

So how accurate are these mobility studies? RAND's report, *Finding the Right Mix of Military Civil Aircraft: Issues and Implications*, indicates the USAF overestimated intertheater airlift utilization rates and average payload planning factors. By analyzing the Gulf War, this report concluded the worldwide utilization rates for military intertheater airlift aircraft were about one-half the planning factor rates used to calculate theoretical airlift capacity. During the heaviest airlift surge of the Gulf War, between December 1990 and February 1991, the worldwide average utilization rate for the C-5 averaged 5.5 hours per day and the C-141 averaged 7.1 hours per day (against the sustained rate planning factors of 9 and 10 hours, respectively) (Gebman et al. 1994b, 79-80). Factors that may have contributed to lower than planned utilization rates included aircraft waiting due to congested airfields; airfield facility and route limitations that slowed the airlift system; longer than planned ground times for refueling, loading, and unloading; and aircraft unavailable due to maintenance.

Actual cargo loads also fell short of the planning factors set forth in the *USAF Airlift Master Plan*. Over the seven months of the deployment and the war, the C-5 averaged 62 tons and the C-141 averaged 19 tons per mission (against planning factors of 68.9 and 27.7 tons, respectively) (Gebman et al. 1994b, 78). RAND questioned whether mission planning rules contributed to the below average payload, or were planning factors too optimistic about how much could be loaded. Concern over fatigue cracks

found in several C-141s could have been a reason. Even though MAC officially waived the 20-ton cargo restriction for C-141s supporting the war effort, this limit may still have been applied. Another issue could have been critical leg length. For the 18 busiest C-5 routes and the 30 busiest C-141 routes, critical leg lengths varied from 3,000 to 3,900 nautical miles, with a median distance of 3,400 nautical miles (Gebman et al. 1994b, 78-79). Since the average payloads achieved by the C-5 and C-141 were similar to what would have been planned for a mission of 3,700 nautical miles, payloads may have been adjusted to account for poor weather.

During Operation Desert Shield and Desert Storm, intertheater airlift produced less than half its theoretical capability. Even though about three-fourths of available military transports supported the Gulf War daily, only 19 MTM/D was transported per day, on average, during the peak month of January 1991. This averaged 3,600 tons over 5,300 nautical miles daily (Gebman et al. 1994a, 14). C-5s averaged 8.2 MTM/D, C-141s 5.9 MTM/D, and the CRAF 4.8 MTM/D daily against the FY1991 *MAC Command Data Book* reported capability of 16.4 MTM/D, 15.5 MTM/D, and 18.1 MTM/D, respectively (Gebman et al. 1994b, 76). The military C-5 and C-141 fleets transported an average of 14.1 MTM/D daily against the reported capability of 31.9 MTM/D. Combined, this represented only 44 percent of DoD's reported military intertheater airlift capability actually used during one of the largest intertheater airlift efforts ever.

Current Intertheater Airlift Operating Environment

Throughout the Cold War, the tension between wartime and peacetime requirements favored wartime requirements. To this end, the United States gradually shifted portions of its airlift capability from the military to the commercial sector as a

cost saving measure. This strategy satisfied the Cold War threat, when the nation could increase its level of effort in predefined stages. The United States' defense posture has changed since the fall of the Soviet Union and the end of the Cold War.

Today, the tension between war and peace is more crucial and airlift policy must be capable of supporting the demands of both. The post Cold War environment is less predictable and full of new intertheater airlift challenges. Combined with ongoing combat operations in Afghanistan and Iraq, the increased demands for MOOTW have stretched the national airlift system's limited intertheater assets. Conducted worldwide, these complex operations include peacekeeping, natural disaster relief, humanitarian assistance, counterdrug, counterproliferation of weapons of mass destruction, and antiterrorism activities. In addition, numerous other organizations place significant peacetime demands on the intertheater airlift system including other United States government agencies, the United Nations, and many allies.

Further complicating the intertheater airlift problem is reduced defense spending. Following the breakup of the former Soviet Union and the aftermath of the Gulf War, America reduced its defense budget by 35 percent (DoD 1997, iii). To protect and save national resources, the USAF underwent a major transition and now has almost three-quarters fewer major forward bases than it once had during the Cold War era (Chow 2003, 8). With the exception of a few critical geographic areas, the United States military is now a CONUS-based power, critically dependent on its intertheater airlift capability for strategic mobility to influence world events.

With the fall of the Soviet Union, the threat of another world war has diminished; however, the threat of smaller-scale conflicts has increased. Due to diverse threats from

aspiring regional powers to transnational aggressors, such as terrorist groups, religious extremists, and drug cartels, the world today is potentially more volatile. The threat today truly spans the globe, potentially placing every United States' citizen and facility at risk.

Secretary of Defense Rumsfeld wrote in the *2001 Quadrennial Defense Review*:

The attack on the United States and the war that has been visited upon us highlights a fundamental condition of our circumstances: we cannot and will not know precisely where and when America's interests will be threatened, when America will come under attack, or when Americans might die as the result of aggression. We can be clear about trends, but uncertain about events. We can identify threats, but cannot know when or where America or its friends will be attacked. We should try mightily to avoid surprise, but we must also learn to expect it. We must constantly strive to get better intelligence, but we must also remember that there will always be gaps in our intelligence. Adapting to surprise - adapting quickly and decisively - must therefore be a condition of planning. (DoD 2001c, iii)

The team relationship between AMC and the CRAF has proven capable of meeting most of the United States' past airlift demands, but does have limitations today. From the beginning of the use of airpower as a means to transport men and material, civil air carriers have augmented military airlift, increasing DoD's overall peacetime and wartime capability. The development of the CRAF program formalized this concept of civil air carriers augmenting military airlift in 1952. Conventional United States' military strategy at the time envisioned the CRAF operating into allied airfields, far from enemy lines, so the physical risk to air carriers would remain low. Yet, as demonstrated in Operation Desert Shield, Desert Storm, Enduring Freedom, and Iraqi Freedom, it was necessary for the CRAF to fly directly into airbases under the threat of surface-to-air missile and chemical attacks. CRAF corporate leadership, aircrews, unions, and stockholders were unprepared to face this situation, revealing understandable problems with carrier risk tolerances and insurance policies.

As civil air carriers were about to begin airlifting troops and equipment to the Persian Gulf, insurance underwriters refused to follow. In early August 1990, several underwriters canceled war risk insurance for carriers operating into Saudi Arabia. This decision created a difficult situation for carriers participating in Operation Desert Shield airlift activities. They would not fly without war risk coverage, but were unwilling to pay the high premiums needed to get it, if it was available at all. This forced the United States government into the business of providing insurance (Benge 2003).

The extension of Title XIII insurance to Operation Desert Shield operations coincided with the United States government's activation of Stage I of the CRAF. With the beginning of hostilities, DoD activated CRAF Stage II. For the aircraft subject to the call-up, Title XIII insurance covered war risk while blanket indemnification provided by the United States government covered all other losses. However, not all of the aircraft participating in this airlift effort were CRAF aircraft. Many operated under ad hoc contractual arrangements. Although all aircraft flying wartime missions were eligible for Title XIII insurance, only CRAF aircraft were supposed to benefit from the blanket government indemnification. The United States government did not strictly observe this distinction, and many of the air carriers engaged in Operation Desert Shield missions used CRAF and non-CRAF aircraft for the same operations (Benge 2003).

The Federal Aviation Administration (FAA) administers Title XIII insurance and issues it with or without a charge. Two major gaps between the FAA and commercial insurance coverage appeared due to the long post-Vietnam hiatus in the Aviation Insurance Program activity prior to the activation of the CRAF in 1990. First, was the inability to cover domestic CRAF flights. Most of the civil air carriers' liability war risk

insurance policies excluded coverage for all CRAF flights while FAA-issued non-premium insurance could cover only international flight segments. Thus, the airlines had to rely on direct indemnification from DoD for coverage of CRAF domestic flights (usually ferry flights to a military base to pick up troops and supplies). In addition, flights transporting armed forces and cargo for the United States government or a foreign government, but not operated under a United States government contract, could not be covered by non-premium insurance. Title IV of the Airport and Airway Safety, Capacity, Noise Improvement and Intermodal Transportation Act of 1992, Publication L. 102-581, gave the FAA the authority to provide non-premium insurance coverage for these two previously uncoverable categories of flights. The FAA has been able to fill other coverage gaps administratively with successive revisions to its insurance policies, such as the costs of search and rescue attempts, runway foaming, and damage while the aircraft is outside the insured's control (Department of Transportation 1997).

The interplay between Title XIII and commercial insurance has given rise to difficult questions of coverage and responsibility. At various points during a flight, a civil air carrier supporting Operation Desert Shield was either fully or only partially covered by its commercial insurance policy. Now that the war is over, civil air carriers and the insurance community are struggling to find solutions to the problems posed by shifting coverage (Benge 2003).

As the Global War on Terrorism continues, the need to operate intertheater airlift in potentially hostile environments is likely to remain a critical requirement to the war fighter. New threats and developments in the global security environment may lead DoD into reshaping the way the CRAF is employed. An adversary can now effectively deny

civil air carriers access to a crisis area by accomplishing a hostile act to a CRAF carrier, or by merely threatening to. An example of the threat civil air carriers now face occurred 22 November 2003 when a SA-7 surface-to-air-missile hit a DHL Airways Airbus 300 cargo aircraft shortly after it took off from Baghdad, Iraq. Fortunately, the damaged aircraft returned to the airport without any injured crewmembers. Coalition authorities, concerned over repeat attacks, suspended further commercial flights (CNN 2003). Prior to this incident, Iraqi insurgents shot down several military helicopters and attempted to down other military intertheater airlift aircraft.

The DHL Airways incident highlighted that in the future, when there is a significant threat to civil air carriers, DoD will have little choice but to restrict the CRAF from operating in hazardous theaters. The *Mobility Requirements Study FY2005* acknowledges the use of chemical weapons would impair the CRAF program during a conflict. To overcome this threat, CRAF carriers would remain outside threatened areas and military or host nation aircraft would then shuttle personnel and cargo to forward APODs in theater (DoD 2001C, 5-4). The disruption of cross loading personnel and cargo from CRAF carriers at intermediate staging bases would delay delivery and increase demands on military airlift aircraft. With this concept of operations, the CRAF remains a vital component supporting airlift requirements, but at a reduced capacity.

Another potential issue is the political and economic consequences of activating the CRAF. During the Gulf War, there was a major backlog of bulk cargo at Dover Air Force Base. To handle the surge, MAC explored recommending activation of the third stage of the CRAF to increase commercial airlift capability from 5 to 17 MTM/D. Major air carriers resisted this activation, citing adverse long-term affects to the competitiveness

of those carriers with large CRAF commitments (Gebman et al. 1994a, 15). Small carriers were eager for the additional business, while larger carriers were reluctant participants because they feared losing lucrative routes and market share to their non-CRAF competitors (or competing carriers that did not make a substantial CRAF commitment). Edward Driscoll, President of the National Air Carrier Association testified before the United States House of Representatives on 10 October 1990 concerning initial problems encountered which affected civil air carrier support of Operation Desert Shield.

A. Crew duty time had to be extended from 100 to 150 hours per month.

B. Title XIII insurance was required to cover war risks, both for military operations as well as commercial flights operating in the Persian Gulf. Provisions governing war risk insurance should be reviewed and revised so that rates to be charged on a premium basis could be set at the rates in effect prior to the emergency.

C. The activation of Stage I necessitated a carrier with draw its equipment from commercial operations and make it available to MAC within 24 hours of notice of call-up. However, the carrier did not receive any compensation for this unless a service order was issued and the carrier operated its aircraft pursuant to that order. (United States, Congress 1990)

Civil air carriers face constant difficulties because of deregulation and tough competition from subsidized foreign carriers. For this reason, the CRAF program favors smaller carriers specializing in charter operations. Most large carriers have abandoned the charter business because they are not competitive with smaller, more flexible carriers. If the United States continues to rely on activating the CRAF frequently to meet intertheater airlift shortfalls, there could be serious consequences. With each stage activated, further disruptions of participating large carriers' operations occur. Air carrier leadership may decide risks to their financial security outweigh the benefits of voluntarily participating in

the CRAF. With defense business declining since the end of the Cold War, the financial incentive for large carriers participating in the CRAF is also declining.

Because of the stress activating the CRAF places upon air carriers, William Hoover, Executive Vice President Air Transport Association of America, recommended DoD fly more hours with its own aircraft and seek commercial airlift only for short periods of time to handle surges and initial buildup. In addition, CRAF Stage I should be activated only when airlift requirements exceed the capabilities of the USAF's organic resources. He stated the airlines are committed to meeting their responsibilities to CRAF, but DoD must be more sensitive to the harm it causes the carriers it uses the most (Hoover 1991, 54-55).

In addition to these problems, a large part of the air carrier industry is becoming less "CRAF friendly." Financial problems are forcing air carriers to reevaluate how they conduct their operations. From their corporate structure, route selections, and even which aircraft they operate. Numerous large carriers, like Pan Am, have gone out of business. Other carriers, like Trans World Airways (prior to their purchase by American Airlines), have reduced their international operations. Still others, like Northwest, have taken on foreign partners to survive.

This has meant an overall decline of large aircraft available for the CRAF program, especially Boeing 747s. United States' air carriers are moving away from purchasing large aircraft, instead, favoring smaller aircraft that offer greater scheduling flexibility. In Europe and the Asia-Pacific region, large freighters claim the greatest share of their cargo fleet--nearly one-third and one-half, respectively. Today, foreign carriers servicing long-haul markets purchase the majority of new large aircraft like the Boeing

747 (Boeing Company 2003c and Boeing Company 2003d). United States' carriers are responsible for only 18 of the 99 orders for new Boeing 747 aircraft over the past five years (1 January 1999 through 31 December 2003). The remaining 81 aircraft are destined for countries such as Australia (6), China (6), France (2), Japan (3), Netherlands (5), Singapore (6), South Korea (10), Taiwan (26), Thailand (4), and the United Kingdom (7). Even more striking, of the 21 orders for new Boeing 747s placed between 1 January 2002 and 31 December 2003, none are destined for the United States (Boeing Company 2003b). This further complicates the ability of the CRAF to contribute.

Since the CRAF allows DoD to avoid the cost of buying aircraft, defense officials studied whether it might be able to expand the program. The USAF examined whether DoD can provide incentives for CRAF carriers to purchase modified Boeing 747-400 freighters. Based on market projections over the next decade, the USAF found that no carriers planned to buy 747-400s, typically, because the aircraft's extensive range and payload capabilities did not fit into the route system and business strategy of those firms.

Eight CRAF participants expressed interest in an enhancement program if DoD covered the added costs of buying 747-400s that are modified to carry military cargo. Since modified 747-400 freighters are heavier than unmodified civil versions, commercial carriers require compensation for higher operating costs because the modified aircraft would be less fuel efficient. In the late 1980s, the USAF modified 24 CRAF commercial Boeing 747s with enlarged cargo doors and reinforced floors at a cost of more than \$600 million so those aircraft could accommodate military equipment. DoD also provided operating subsidies to pay for the additional fuel those planes required. This program was not considered a success. Pan Am, the carrier with the largest number

of planes modified under the program, went bankrupt in 1991 and the USAF lost access to many of those aircraft after foreign airlines purchased them. For that reason, some analysts believe that a similar enhancement program today would be risky. In the fall of 1995, the Air Force Chief of Staff, General Ronald Fogleman, told reporters that the service would not reenter the business of providing operating subsidies to United States' air carriers (United States, Congressional Budget Office 1997, 88).

Today's dynamic operating environment also greatly complicates DoD's ability to rely on civil air carriers, potentially threatening the CRAF's capability to fulfill its portion of the nation's airlift demands. In the CRAF's entire history, Stage III has never been activated and a partial Stage II has only been activated once, during Operation Desert Shield and Desert Storm. In light of these problems, activating the CRAF's Stage III might not be possible, except when there is a direct threat to the nation's very survival.

DoD Intertheater Airlift Cargo Requirements

Today's scenarios may require a greater percentage of bulk and oversize cargo. Delivering large amounts of outsize equipment to North Atlantic Treaty Organization's well-prepared airfields was once the critical concern. In 1981, the North Atlantic Treaty Organization-Warsaw Pact scenario requirement consisted of 73 percent of the cargo airlifted to be bulk or oversize (United States, General Accounting Office 1995, 18). In the post-Cold War environment, the DoD may now face the challenge of how best to deliver a mix of mostly bulk and oversize cargo into theaters lacking the preparation and resources that exist in Western Europe. During Operation Desert Shield and Desert Storm, from August 1990 through February 1991, the USAF estimated 88 percent of the cargo shipped by air was bulk or oversize (66 percent bulk, 22 percent oversize)

(Gebman et al. 1994b, 25). With such a low percentage of outsize cargo delivered, commercial aircraft were well suited to meet the Gulf War's intertheater airlift demand.

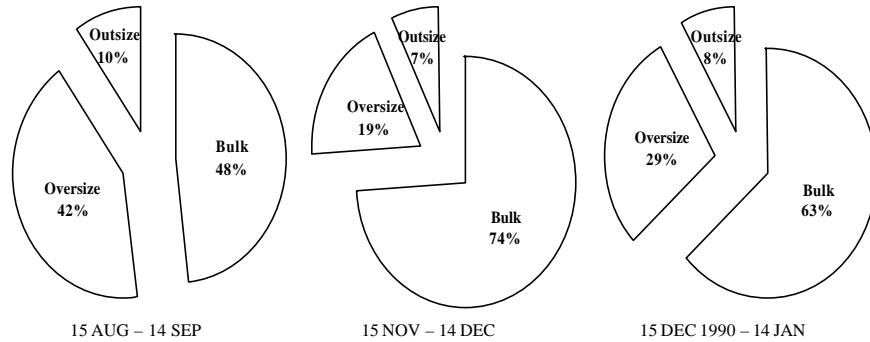


Figure 1. Estimated Mix of Operation Desert Shield Cargo Loads

Source: Jane R. Gebman, Lois J. Batchelor, and Katherine M. Poehlman, *Finding the Right Mix of Military Civil Aircraft: Issues and Implications*, Vol. 2, Analysis (Santa Monica, CA: Rand Corporation, 1994), 26.

Unfortunately, sources vary greatly on current DoD intertheater airlift requirements for bulk, outsize, and oversize cargo. AMC did not capture deployment data on the percentage of cargo categories it airlifted during Operation Enduring Freedom or Iraqi Freedom. Instead, their metrics focused on total number of passengers and short tons of cargo delivered (Effrecc 2004). Normally, to determine airlift requirements, the Joint Planning and Execution System process uses a time-phased force and deployment data (TPFDD) to plan as well as execute the deployment of an operation. Based on the speed as well as lack of discipline to the process during the Operation Enduring Freedom and Iraqi Freedom deployments, the TPFDD was not used in many cases, which resulted

in ineffective transportation asset utilization as well as lost deployment data (Effrece 2004).

Because the bulk cargo category includes such a diverse range of material in quantities that are difficult to forecast, past airlift studies tended to focus on equipment that are easier to measure such as tanks, trucks and helicopters. Moreover, since many types of bulk cargo can be pre-positioned, there has been a tendency not to fully consider airlift's bulk cargo requirements. This type of cargo includes numerous items such as expensive test equipment, spare parts, food, clothing, and ammunition. In all phases of Operation Desert Shield, palletized bulk cargo was the single largest category transported. This airlift effort indicated a need that has always been present but may also be the consequence of deploying to a theater lacking a significant infrastructure, unlike that in Europe (Gebman et al. 1994c, 8).

The possible shift in demand from outsize to bulk and oversize cargo provides an opportunity to rethink DoD's intertheater airlift composition. Since the C-17 can carry most outsize cargo, efficiency could be gained simply through better command, control, and communication. Simply by matching individual aircraft types with appropriate loads, delivery method requirements, and airfields may increase DoD's intertheater airlift capability. This will require greater in-transit visibility of the cargo than currently exists. By matching the type of aircraft with the cargo, commercial cargo carriers realize a 10 to 20 percent increase in payload. They exploit the capabilities of particular types of aircraft by organizing the cargo to maximize the utilization of the aircraft's volume. As an example, during the Gulf War, missions scheduled for C-5s exceeded their availability on several occasions. This created the impression MAC had exceeded its capability for

outsize airlift. During these periods, however, C-5s transported oversize and bulk cargo as well outsize (Lund, *et al.* 1993, 56). By matching cargo loads to appropriate aircraft types, could MAC have met DoD's outsize cargo needs while other aircraft, including the CRAF, serviced bulk and oversize requirements?

Military Versus Commercial Intertheater Airlift Aircraft Benefits

Worldwide commitments dramatically increased since the end of the Cold War. To move people and cargo quickly to influence world events, the United States has relied on a combination of military and contracted commercial aircraft. This "team" approach proved itself during Operation Desert Shield, where AF Chief of Staff General Merrill A. McPeak described MAC's contribution "as the equivalent of a Berlin Airlift every six weeks" (AMC, Public Affairs 2003). Military-style aircraft, like the C-141, served a vital purpose, but often commercial-style aircraft were more desirable during the Gulf War for two reasons. First, they delivered more cargo for the ramp space used, thus maximizing limited real estate at destination airfields. Second, they delivered more cargo per gallon of fuel used, saving theater fuel supplies (Gebman *et al.* 1994a, 18).

The CRAF's commercial aircraft continue to transport the vast majority of DoD personnel and a significant portion of bulk cargo yearly for AMC. Under the *Mobility Requirements Study FY2005*'s two Major Theaters of War scenario, the CRAF would be required to move 20.5 MTM/D, including 41 percent of all military bulk cargo and 93 percent of passengers (United States, General Accounting Office 2002, 9). Commercial aircraft have proven themselves as well suited to move huge numbers of combat troops

and massive amounts of cargo in minimum time and will continue to be a critical component of the United States' ability to project its military forces rapidly.

Military-style aircraft have unique characteristics that are useful for a variety of military-specific missions. Some of these characteristics aid in the performance of intertheater missions, while others aid in the performance of intratheater missions. To meet demanding DoD requirements, military-style intertheater airlift aircraft are designed with special features such as high-mounted wings, larger control surfaces, strengthened landing gear, aerial refueling equipment, and large, easy access cargo doors. In addition, military transports often have special defensive systems to improve survivability during combat conditions.

Unfortunately, these design features come at a cost. They add weight, reduce speed, increase fuel consumption, and require additional maintenance. This translates into extended ground stops, increased flight time to a crisis area (if aerial refueling is not used), and ultimately, greater operating costs. As an example, the wartime mission capability rate requirement for AMC's fleet of C-5s is 75 percent, but C-5s constantly struggle to maintain actual mission capability rates above 59 percent due to increased maintenance required to keep complicated systems functioning (AMC 2002, 111). Thus, the distinguishing feature of military-style aircraft is flexibility since they are typically able to carry more types of cargo, to more places, under more threatening conditions than commercial-style aircraft.

Although the lack of mission flexibility means commercial-style aircraft has limited utility when applied to specialized military missions, it also means lower costs for the cargo it carries. Optimized specifically for carrying bulk and certain oversize cargo,

commercial-style cargo aircraft offer the least costly solution when operating into well-established airports. Thus, the most distinguishing feature of commercial-style aircraft is their economic efficiency.

The C-17 is the most flexible airlift aircraft because it can deliver outsize cargo directly into airfields with short runways, back up on inclined surfaces, evade threats by flying tactically, and rapidly offload cargo by either airdrop or by built-in ramps used at airfields with limited material handling equipment. But, flexibility extends beyond just aircraft capability within AMC's intertheater airlift force. The current procurement of 180 C-17s to replace 266 aging C-141s will increase the capability to deliver personnel and cargo directly from CONUS bases into relatively austere airfields in a combat zone. This is a key combat enabler that no other country possesses, but decreases flexibility since 86 less airframes will be available to meet combatant commanders' needs. Therefore, when the quantity of airframes is increased, flexibility is also gained.

The C-17's avionics, optimized for the tactical environment, offers additional flexibility over commercial aircraft in a tactical environment. Even in poor weather conditions, the C-17 can navigate into austere airfields that possess no navigation aids. This capability becomes more important in regions that do not have well-developed infrastructures. Korea and Southwest Asia have relatively mature airfield infrastructures. Therefore, smaller, austere fields are not very important. However, in regions with less developed infrastructures, like many areas within Africa, the use of small airfields by the C-17 could be crucial.

Outside a tactical environment, commercial-style aircraft are typically better equipped to use the world's air route and instrument landing systems. This reduces pilot

workload and permits commercial airlines access to properly equipped CAT II and CAT III airports, even during periods of extremely poor weather.

Precisely because of their mission flexibility, military-style intertheater airlift aircraft will absolutely be crucial for future combat operations, as Operation Iraqi Freedom demonstrated in 2003. The C-17 made possible the rapid deployment of combat forces into and within Iraq. In addition, the unique capabilities of the C-17 solved the access problem of how to open and sustain a northern front despite Turkey's refusal to permit United States' troops to stage from its soil.

Flying at night with the aid of night vision goggles, fifteen C-17s parachuted 954 troops of the Army's 173rd Airborne Brigade into northern Iraq on the night of 26 March 2003. C-17s deployed another 1,200 troops to Iraq's Bashur airfield over the next few nights. On 8 April 2003, C-17s began the delivery of five US Army M1A1 tanks, five Bradley fighting vehicles, fifteen M113 armored personnel carriers, and forty-one Humvees, along with other equipment. This marked the first time the Abrams tank had been airlifted directly into a combat area; and the airdrop of troops marked the C-17's first combat personnel drop (Tirpak 2003, 26). The C-17 was the only intertheater airlift aircraft capable of operating on unimproved runways and one of only two aircraft (the other is the C-5) able to airlift the Abrams tank (the C-17 limit is one Abrams per aircraft, per mission). "The reason we had a northern front in Iraq was because of the C-17," asserted Major General Roger A. Brady, AMC's director of operations. "It has the capability to carry a lot of people and supplies into relatively short strips and that's a unique characteristic of that airframe." Major General Brady also stated, "We did take in

some tanks . . . in some other operations in southern Iraq. Obviously, at one tank per [aircraft], it's not the preferred way to move tanks" (Tirpak 2003, 26).

When combined, military-style and commercial-style aircraft provides the United States with its global reach, because each type of aircraft has distinct advantages.

Military and Commercial Intertheater Airlift Procurement and Operating Costs

Since there are less trade-offs for special capabilities, commercial aircraft are typically cheaper to purchase and operate than their military counterparts. Optimized to transport bulk and certain oversize cargo, commercial aircraft are also more efficient than their all-purpose military counterparts are. This section details the purchase and operating costs of a C-17 versus a Boeing 767-300F.

The purchase price of a Boeing 767-300F is considerably less than the C-17. Boeing lists the price of a 767-300F from \$122.5 to \$134 million, depending on overall configuration (Boeing Company 2003a). Compare this to \$236.7 million (FY98 constant dollars) per C-17 (USAF 2003a). It is impossible to predict the negotiated price of purchasing a fleet of commercial Boeing 767 aircraft. However, using the Institute for Defense Analysis projections for the Boeing KC-767A tanker-variant shown in Table 2 (based on a Boeing 767-200ER instead of a 767-300F) allows for an approximate estimate. Assuming costs associated with development and modification remain similar for a Boeing 767-300F (\$20.4 million) and increasing the cost of enhanced features from \$1.6 million to \$5 million to meet military-specific cargo specifications, such as an enlarged cargo door, modification might add \$25.4 million to the baseline price of \$122.5. Deleting the costs associated with tanker-specific requirements, such as additional auxiliary fuel tanks and other refueling modifications, each cargo Boeing 767-

300F could cost \$147.9 million. This would enable DoD to purchase roughly eight commercial Boeing 767s for every five military C-17s. Using these estimated figures, procuring 42 Boeing 767s instead of an equal number of C-17s would save DoD \$3.73 billion.

Table 2. Summary of KC-767A Tanker-Variant Purchase Price Analysis

Taxonomy Element	IDA Unit Price Estimate (FY02 \$M)	Primary Analysis Technique	Primary Data Sources
Basic B767-200ER	72.1	Commercial Pricing	Consultants, Department of Transportation data
Enhanced B767-200ER Features	1.6	Commercial Pricing	Consultants, Boeing, USAF data, IDA models, vendor quotes
Combi Modifications	9.5	Commercial Pricing	Consultants, public data
Auxiliary Fuel Tanks	6.3	Cost analysis	Vendor quotes, IDA models
Tanker and Other Modifications	20.3	Cost analysis	IDA models, USAF, Boeing
Development Costs	10.9	Cost analysis	USAF, IDA models
<i>Total</i>	<i>120.7</i>		

Source: J. Richard Nelson, "Testimony Before the Senate Armed Services Committee on the Purchase Price Estimate for the KC-767A Tanker/Combi Aircraft.", 2003, 85; [database on-line]; available at http://www.globalsecurity.org/military/library/congress/2003_hr/nelson.pdf, internet, accessed 28 December 2003.

Since military and commercial sectors use different accounting methods, direct comparison of operating costs between the two is difficult. Table 2 depicts 1996 data collected by the Department of Transportation. The USAF's data represents the forecast hourly operating cost based on fuel and oil, 40 percent of depot engine maintenance, flying supplies, depot level repairables, and crew travel. Readily apparent in this data is the impact of high maintenance costs for the C-5 fleet. The data for commercial aircraft represents the forecast for fuel and oil, rentals, insurance, taxes, airframe maintenance, engine maintenance, maintenance burden, and crew costs. Some of these factors increase

the cost considerably. Commercial carriers pay taxes and insurance, whereas DoD does not. Commercial carriers also maintain higher crew ratios per aircraft and pay higher salaries than the military, thus incurring higher crew costs. By subtracting taxes, insurance, and crew expenses, commercial freight carrier's average hourly operating cost in 1996 for the Boeing 767 was \$1,304 compared to \$5,075 per flying hour for the C-17 (Hoffer et al. 1998, 4-30 and 4-44).

Besides reduced procurement and operating costs, purchasing an established commercial aircraft also provides additional cost benefits. The first Boeing 767-300F rolled out of the factory in May 1995 (Boeing Company 2003a), thus, the commercial industry has already absorbed a significant portion of research and development costs. Since Boeing's assembly line continues to produce new 767-300Fs, there is also little risk of incurring the usual cost overruns commonly associated with new airframes since development costs would be limited to minor design improvements to meet military-specific requirements and retooling manufacturing facilities.

Table 3. Flying Hour Cost Estimates and Cargo Payloads

AIRCRAFT*	Per Flying Hour Costs ***				Cargo Payloads		
	Fuel Burn Rates (US Gal)	Fuel & Oil	MX	Total Costs	Pallet Positions	ACL (Short Tons)	Planning (Short Tons) ****
C-5B	3,453			\$6,087	36	89	61.3
C-17A **	2,932			\$5,075	18	65	45
Boeing 767-300F	1,575	\$989	\$315	\$1,304	24	67	58
2-Eng Wide Body Jet		\$1,152	\$780	\$1,932			

* C-5B and Two-Engine Wide Body Jet (based on composite information of data collected on the class) included for comparison.

** Air Force Instruction 65-503 lists the C-17's total cost per flying hour as \$2,804 (FY 2004 Constant Dollars). This figure included supplies, fuel, and organic maintenance and repair, but did not include contractor logistic support. This document also lists the cost per flying hour for the C-5B as \$10,690 (United States Air Force 2004, Attachment A2-1).

*** Costs in this section represent 1996 data collected of Air Freight Carriers with annual revenues of at least \$100 million by the Department of Transportation and USAF Financial Management sources. Civil carrier-specific costs associated with crews, depreciation, insurance, and rental charges were removed. Boeing 767 fuel costs include total fuel and oil consumed divided by total airborne hours. Maintenance costs include labor, parts, materials, and burden for aircraft and engine maintenance.

**** Military aircraft ACL based on 3200nm leg; commercial aircraft ACL based on 3500nm leg.

Acronyms: ACL Allowable Cargo Load MX Maintenance

Source Data: Fuel Burn Rates, Cargo Payloads (United States Air Force 2003b, 17 and 12); Fuel & Oil, Maintenance, Total Costs (Hoffer et al. 1998, 4-32 and 4-44)

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

We are now engaged in a global war with an elusive and resilient enemy who does not employ traditional means of warfare. These new realities underscore the absolute necessity to adapt our force. As airmen, I ask you to treat "transformation" as a mindset rather than a process. It is a state of mind that is willing to explore adaptations of existing and new systems, doctrines, and organizations--one that will allow us to be truly relevant in the era in which we find ourselves.

Dr. James G. Roche, Secretary of the Air Force

Conclusions

In order for AMC to possess an organic capability sufficient to meet the demands of a major crisis, an intertheater airlift fleet several times greater than usually required during peacetime will be required. Historically, DoD has maximized both cargo carrying capacity and mission flexibility by augmenting its organic assets with CRAF aircraft and crews. By maintaining their reserve airlift capability in the CRAF, DoD has on call a substantial airlift capability for a relatively small cost. The reverse is not true for maintaining the same reserve capacity in DoD.

The combined capabilities of AMC's organic intertheater airlift fleet and their CRAF counterparts made possible both the swift buildup of combat power during past conflicts, as well as the quick return of forces after the crisis was over. Military-style aircraft, like the C-17, provided essential capabilities unmatched in the commercial market to project forces worldwide, and they will remain vital to DoD's ability to meet *National Security Strategy* objectives. Despite the impressive capability and capacity of AMC's organic intertheater airlift fleet, DoD will remain reliant on commercial-style

aircraft operated by the CRAF to move a significant portion of its personnel and cargo. The CRAF's cost effectiveness during peacetime and its proven record in wartime makes its successful continuation essential.

However, the environment the CRAF operates in has changed. The proliferation of man-portable missiles, combined with a potential adversary's willingness to use them, now places CRAF aircraft and aircrews in jeopardy. In 1942, the United States Army Air Corps increased its acquisition of C-47s, a military version of the commercial DC-3, when the commercial airline Pan Am could not keep pace with the airlift requirements of supplying China from Burma. This airlift operation was dangerous and led to the loss of 460 transports and 792 crewmembers (USAF 1991). The dangers of the Burma Hump demonstrated the military could order its crews to fly anywhere. Operating in hostile environments is the duty and responsibility of the military and should not be asked of civilians. Although protection of CRAF aircraft and aircrews cannot be assured everywhere, it is politically infeasible, corporately irresponsible, and economically unthinkable to expect civil air carriers to operate in known high-threat areas.

In light of this new threat environment, can DoD continue its dependence on the CRAF airlifting personnel and cargo into crisis areas? If there is any doubt, AMC's organic fleet must increase to meet combatant commanders' wartime requirements since the United States' *National Security Strategy* will continue to place high demand on intertheater airlift forces. So what is the best method for expanding AMC's organic fleet of intertheater airlift? This thesis asks whether complementing AMC's current military-style aircraft fleet with commercially available aircraft is the most fiscally responsible option for solving DoD's intertheater airlift shortfall?

Since DoD will continue to procure and operate its intertheater airlift fleet from a fiscally constrained budget, it is vital to invest wisely in the optimum mix of aircraft and capabilities. Determining the proper airlift composition is a complex and demanding task because it involves tradeoffs between cost saving potential and mission flexibility that ultimately has wartime implications for the United States. Investing too heavily in cargo carrying capacity at the expense of mission flexibility can produce a large fleet unable to respond to critical demands like direct delivery of outsize cargo and airdrop operations. On the other hand, investing too heavily in mission flexibility can provide a very versatile fleet, but procurement and operating costs are greatly increased.

Commercial-style aircraft are typically cheaper to purchase and operate, fly faster, have greater range, and are generally more reliable than comparable military-style aircraft. As a complement to the C-5 and C-17, transporting bulk and certain oversize cargo would be cheaper than using purely military-style aircraft alone. AMC could then optimize the use of its military-style aircraft by dedicating them to the specialized tasks they excel at such as transporting outsize cargo, direct delivery, and airdrop operations. An additional benefit of operating similar aircraft as civil air carriers is the commercial worldwide network of airport facilities and equipment could be used during peak times, thereby reducing congestion at en route military airfields. Furthermore, since the USAF would own and crew these commercial-style aircraft, they could operate directly into high-threat areas denied to CRAF carriers.

Commercial-style aircraft are not without disadvantages. Built for efficiency, they typically require longer runways and specialized material handling equipment. Since DoD is already heavily dependant on the contributions of the CRAF, current airfield

facilities and support plans already address the majority of these shortfalls. For instance, the USAF addressed the special material handling requirements issue by procuring a sufficient number of high-reach-capable loaders for every USAF airfield capable of receiving a commercial-style aircraft.

Procurement of a commercially available aircraft could occur almost immediately. Research and development costs would be minimal since few modifications would be required. Furthermore, by limiting modifications, DoD benefits by leveraging the investment already made by the civil aviation industry. General Henry H. "Hap" Arnold said, "Airpower is the total aviation industry." Since airpower is the combination of military and civilian capability, purchasing a commercial-style aircraft will also benefit the civilian sector since manufacturing and production lines will remain open longer. Limitations to this solution, therefore, should only involve production schedules of the aircraft manufacturer.

Recommendations

Complementing the USAF's projected intertheater airlift fleet of 180 C-17s with a viable, efficient, and reliable commercial-style cargo aircraft is the most economically feasible solution to DoD's intertheater airlift shortfall for three major reasons. First, the greater speed, range, and cargo carrying capacity ensure a more efficient response delivering the majority of cargo needs (bulk and certain oversize cargo) to major crises. Second, more aircraft could be fielded and operated for the same investment, increasing flexibility to adapt to a wider variety of intertheater airlift requirements. By leveraging the inherent benefits of both styles of aircraft, DoD would realize tremendous cost savings while increasing its ability to meet combatant commander's needs. Third, these

military owned and operated commercial-style aircraft could fly into areas denied to CRAF aircraft and crews.

However, the quantity of commercial-style aircraft that DoD fields should be limited. The need for a robust military-style intertheater airlift capability to meet direct delivery, outsize cargo, and airdrop requirements are not likely to disappear. For economic and political reasons, neither is DoD's reliance on the CRAF. The size of DoD's commercial-style aircraft fleet should be dependant on its bulk and outsize cargo airlift requirements for high-threat theaters. The combined fleet of DoD owned and operated commercial-style and military-style intertheater airlift aircraft should fill critical needs in high-threat areas while civilian CRAF aircraft and crews fulfill needs in more threat appropriate regions.

Due to demanding private industry requirements, basic model commercial aircraft possess a tremendous amount of capability right out of the box. Therefore, the USAF should consider limiting modifications to the bare minimum required to meet military-specific requirements. These modifications include enlarging the cargo door, reinforcing the cargo floor, and adding a defensive system against missile threats.

Enlarging the cargo door would permit bigger oversize cargo to be loaded and add substantial utility. Although a stronger floor would also increase the amount of oversize cargo on a commercial aircraft, the USAF needs to assess the costs and benefits of such a modification. If the commercial-style aircraft selected already accepts the majority of anticipated cargo, spending more than a few million dollars per aircraft may not be justified. Lastly, due to the threat of man-pad surface-to-air missiles, installation of a defensive system to provide some level of protection should be a mandatory requirement.

Another capability to consider would be aerial refueling. However, adding this capability is very costly. Not only in terms of aircraft modifications, but also in training and support requirements. Aircrews require constant training to maintain aerial refueling proficiency. To meet these additional requirements, more tanker aircraft and crews might be required. Especially since tanker assets are also limited and in high demand.

Fortunately, a military version of a commercial-style aircraft may not benefit greatly from an aerial refueling capability. Commercial aircraft typically fly further between refueling and their higher reliability make them less likely to experience a maintenance delay during en route stops. Consequently, there does not appear to be a requirement to justify the added expense of adding an aerial refueling capability.

Airlift is the backbone of the United States' national military power. Prior to the United States entry into World War II, Major General Henry H. "Hap" Arnold and Colonel Ira C. Eaker wrote, "There is a greater likelihood that poor strategy will cause the overthrow of nations than poor tactics" (Arnold and Eaker 1941, 140). The world has changed. The United States faces a different strategic environment than it faced during the Cold War and must reexamine the policy mismatch between its *National Security Strategy* and *National Airlift Policy*. To remain relevant, national airlift policy must be updated from the Cold War paradigm of total mobilization for war to reflect the diverse requirements of the United States as a sole world superpower. To meet national security objectives, the United States must broaden its airlift policy to permit acquiring the most generally capable airlift, whether commercial or military, to maximize its flexibility and throughput capability.

Once fielded, the Reserve Component would be the best suited to operate and maintain AMC's limited fleet of commercial-style intertheater aircraft for two major reasons. First, a significant portion of part-time Reservists and Guardsman would operate similar systems in their full-time civilian jobs. Thus, DoD would not only leverage the private aviation industry's technology in aircraft but also its experienced workforce. Secondly, by focusing on basic airlift qualifications, instead of specialized events like airdrop operations and aerial refueling, training requirements for part-time Reservists and Guardsman would be more manageable, always a concern due to the limited time most of them are able to devote to training. These crews could maintain proficiency during a typical two or four-hour flying training period. Additionally, by limiting the focus of commercial-style aircraft crews, the rest of AMC's crews would have greater access to high-demand tankers and ranges for their specialized training. Thus, the aircrews operating military-style aircraft also have the potential of realizing an improvement to their proficiency as well.

Areas for Further Research

While conducting this study, the author identified several areas concerning intertheater airlift that would benefit from further research. First, what is the optimum mix of military and commercial intertheater airlift aircraft to meet military requirements? Second, which commercial-style aircraft is best suited for DoD's intertheater airlift requirements and should it be procured to augment AMC's current military-style airlift fleet? Third, how can USTRANSCOM more efficiently and effectively use its military and CRAF resources to reduce the current airlift shortfall? Specifically, can improved

scheduling of existing aircraft increase utilization and realize additional intertheater airlift capability?

Airlift solutions alone are not likely to solve the United States' overall mobility shortfall. Each leg of the mobility triad has its own proponents who believe that, given enough money, they can fix the strategic mobility problem. The proponents of airlift want more C-17s. The proponents of sealift want more high-speed Theater Support Vessels. The proponents of pre-positioning want more land-based and afloat pre-positioned stocks.

High-speed sealift may be the more responsive component that bridges the nation's strategic mobility gap. The majority of the politically significant urban areas around the world are located in littoral areas. Since the cost of procuring sufficient intertheater airlift aircraft may be too prohibitive, a more economically feasible solution may be additional theater support vessels that costs between \$65 million and \$85 million and have twelve times the cargo capacity of the C-17. Procuring 42 more C-17s than the 180 currently authorized would cost roughly \$9.9 billion. On the other hand, it would cost only \$6.5 billion to procure fifty-six high-speed Theater Support Vessels and twelve large, medium-speed, roll-on-roll-off vessels. Adopting this force structure would save over \$3 billion (Hickens 2002).

Summary

During the course of this study, the author discovered that the movement of cargo and passengers is a complex and vitally important process. The subject of intertheater airlift will continue to be critical to military professionals as long as our national policies require rapid movement of forces anywhere in the world. The continued alignment of the

USAF into Air Expeditionary Forces and the United States Army's Future Force concept are just two indicators that future military operations will require significant amounts of airlift. To prove the continuing need for airlift, one only has to look at current events. As 2004 began, the United States was involved in the Global War on Terrorism, post conflict operations in Iraq and Afghanistan, and numerous other missions in the Horn of Africa, Korea, and other parts of the world. With limited forces available, intertheater airlift will continue to be a key enabler in meeting future challenges ahead.

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